THE ROLE OF COMMUNITY ENERGY PLANNING IN DECENTRALIZATION POLICIES OF TURKEY

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submitted by **ESENGÜL ERKAN** in partial fulfillment of the requirements for the degree of **Master of Science Urban Policy Planning And Local Governments, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Yaşar KONDAKÇI
Dean
Graduate School of Social Sciences _____

Assist. Prof. Dr. Ömür BİRLER
Head of Department
Urban Policy Planning And Local Governments _____

Assoc. Prof. Dr. Meltem ŞENOL BALABAN
Supervisor
Department of City And Regional Planning _____

Examining Committee Members:

Assoc. Prof. Dr. Meltem ŞENOL BALABAN
Middle East Technical University
Department of City And Regional Planning _____

Assoc. Prof. Dr. Mustafa Kemal BAYIRBAĞ
Middle East Technical University
Department of Political Science And Public Administration _____

Assoc. Prof. Dr. Fatih Cemil ÖZBUĞDAY
Ankara Yıldırım Beyazıt University
Department of Economics _____

I hereby declare that all information in this document has been obtained and presented by academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: Esengül ERKAN

Signature:

ABSTRACT

THE ROLE OF COMMUNITY ENERGY PLANNING IN DECENTRALIZATION POLICIES OF TURKEY

ERKAN, Esengül
M.Sc., The Department of Urban Policy Planning And Local Governments
Supervisor: Assoc. Prof. Dr. Meltem ŞENOL BALABAN

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The thesis examines the applications of renewable energy towards community energy as an urban policy in the local governments of Turkey. A comprehensive study was conducted on the energy production and consumption from renewable energy in the world and in Turkey, and the increase in global renewable energy activities in recent years was discussed together with issues such as climate crisis and localization. In the discussions on political, administrative, and financial decentralization and privatization policies, the representatives such as central and local governments, private sector, and non-governmental organizations are included. In the development process of the electricity sector in Turkey, incentive mechanisms for fossil fuels and renewable energy sources were developed and privatizations started within the scope of the objectives of ensuring electricity supply security and increasing renewable energy production. It has been identified that the practices in different countries are supported by support mechanisms, national enabling frameworks, the increase in the number of participants, and local energy activism. When the community energy is considered as a part of urban policies in Turkey's local governments, it has been defined there are some purposes such as reducing energy costs, generating income through the sale of excess production to the grid, or meeting climate targets. In the results section of the thesis, suggestions were presented in order to encourage solar

energy applications with high environmental and economic returns for urban policy planning in Turkey.

Keywords: Community Energy, Decentralization, Renewable Energy, Solar Energy

ÖZ

TÜRKİYE'NİN YERELLEŞME POLİTİKALARINDA TOPLULUK ENERJİ PLANLAMASININ ROLÜ / THE ROLE OF COMMUNITY ENERGY PLANNING IN DECENTRALIZATION POLICIES OF TURKEY

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Yüksek Lisans Tezi, Kentsel Politika Planlaması ve Yerel Yönetimler Bölümü
Tez Yöneticisi: Assoc. Prof. Dr. Meltem ŞENOL BALABAN

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Bu tez, Türkiye’nin yerel yönetimlerinde bir kentsel politika olarak yenilenebilir enerjinin topluluk enerjisine yönelik uygulamalarını incelemektedir. Dünyada ve Türkiye'de yenilenebilir enerjinin üretimi ve kullanımı hakkında kapsamlı bir çalışma yapılarak son yıllarda küresel yenilenebilir enerji faaliyetlerinde yaşanan artış, iklim krizi ve yerelleşme konuları ile birlikte tartışılmıştır. Enerjiye yönelik kamu politikalarına dahil olan merkezi hükümet, yerel hükümetler ile özel sektör ve sivil toplum kuruluşları gibi temsilcilerin siyasi, idari ve mali yerelleşme ve özelleştirme politikalarındaki yerleri tartışmaya dahil edilmiştir. Türkiye’de elektrik sektörünün gelişim sürecinde, elektrik arz güvenliğinin sağlanması ve yenilenebilir enerji kaynaklarından üretilen elektriğin artırılması hedefleri kapsamında, fosil yakıtlara ve yenilenebilir enerji kaynaklarına yönelik teşvik mekanizmaları geliştirilmiş ve özelleştirmeler devreye alınmıştır. Türkiye'nin yerel yönetim sisteminde kentsel politikaların bir parçası olarak topluluk enerjisi ele alındığında, enerji maliyetlerinin düşürülmesi, fazla üretimin şebekeye satışı yoluyla gelir elde edilmesi veya iklim hedeflerinin karşılanması gibi amaçlar ile gündeme alındığı tespit edilirken farklı ülkelerdeki uygulamaların destek mekanizmaları, ulusal etkinleştirici çerçeveler, katılımcı sayısının ve yerel enerji aktivizminin artışı ile desteklendiği görülmüştür.

Tezin sonucunda, Türkiye'deki kentsel politika planlamalarında talep odaklı, yerel yönetimler için çevresel ve ekonomik getirisi yüksek olan güneş enerjisi uygulamalarının teşvik edilmesine yönelik öneriler sunulmuştur.

Anahtar Kelimeler: Güneş Enerjisi, Topluluk, Yerelleşme (adem-i merkezileşme), Enerjisi, Yenilenebilir Enerji

In Loving Memory of My Dad Gültekin Erkan,

To My Precious Family,

and Friends…

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TABLE OF CONTENTS

PLAGIARISM iii
ABSTRACT iv
ÖZ vi
DEDICATION viii
ACKNOWLEDGMENTS ix
TABLE OF CONTENTS x
LIST OF TABLES xii
LIST OF FIGURES xiii
LIST OF SYMBOLS AND ABBREVIATIONS xiv
CHAPTERS
1. INTRODUCTION 1
    1.1. Background 1
    1.2. Aim of the Thesis 6
    1.3. Research Methodology 7
    1.4. Scope 9
    1.5. Organization of the Thesis 9
    1.6. Limitations 12
2. IMPORTANCE OF RENEWABLE ENERGY AND SOCIAL EVOLUTION 14
    2.1. Introduction 16
    2.2. Renewable Energy Outlook 22
    2.3. Decentralization Policies and Energy Planning 25
        2.3.1. Approaches For Energy Communities 27
        2.3.2. Community Energy 34
    2.4. Energy Communities in the World 42
        2.4.1. The UK 42
        2.4.2. Germany 43
        2.4.3. Canada 45
        2.4.4. Denmark 46
        2.4.5. Poland 47

2.5. Concluding Remarks 48
3. RENEWABLE ENERGY RELATED LOCAL ACTIVITIES IN TURKEY 50
3.1. Introduction 50
3.2. Development of Renewable Energy in Turkey 53
3.2.1. Drivers for Renewable Growth 57
3.2.2. Challenges for Renewable Growth 62
3.3. Community Energy in Turkey 66
3.3.1. Historical Development 67
3.3.2. Related Local Activities 74
3.4. Concluding Remarks 79
4. THE CASE STUDY 84
4.1. Introduction 84
4.2. Selection of Land to Install Solar Panel 86
4.2.1. Facility Consumption Information 87
4.2.2. Financial Analysis 88
4.3. Conclusion 91
5. CONCLUSION 94
5.1. Conclusion 94
5.2. Recommendations for Further Research 98
REFERENCES 99
APPENDICES
A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE 105
B. SOME OF THE MUNICIPALITIES THAT WANT TO DEVELOP SOLAR ENERGY PROJECTS WITH ILBANK SUPPORT 106
C. INSTALLED POWER GENERATION, YEKDEM SUPPORTS AND INCOME ITEMS FOR 3 DIFFERENT TYPES OF RENEWABLE ENERGY CURRENTLY IN PRODUCTION 110
D. THESIS PERMISSION FORM 111

LIST OF TABLES

Table 1.1. List of relevant interviewees 8
Table 2.1. World population growth, 1993-2019 versus 2019-2045 (millions) 17
Table 2.2.Sub-sectors and assets included in power sector investment 18
Table 2.3. Distribution of the global economy, 2019 and 2045 (%) 21
Table 2.4. Share of energy-related global CO2 emissions (%) 23
Table 3.1. Basic legal arrangements made in Turkey in the field of renewable energy between 2000-2020 55
Table 3.2. Breakdown of installed capacity by energy resources in 2019 and 2020 57
Table 3.3. Legislation and regulations affecting energy cooperatives 69
Table 3.4. Country ratings for community energy structures (author's evaluation) .. 82
Table 4.1. Solar panel information 87
Table 4.2. Inverter information 88
Table 4.3. Installation cost account 89
Table 4.4. Depreciation table 90

LIST OF FIGURES

Figure 2.1. Approaches for energy communities 15
Figure 2.2. Growth in primary energy demand by fuel type, 2019-2045 21
Figure 2.3. Renewable power capacity growth (2020) 24
Figure 2.4. Political, administrative and fiscal decentralisation 25
Figure 2.5. Decentralization policies which affecting local energy planning..... 26
Figure 2.6. The guiding principles for citizens energy communities in the EU 38
Figure 2.7. Possible legal structures for energy communities 41
Figure 3.1. Renewable power generation capacity by year in Turkey (2000-2019), MW 58
Figure 3.2. Montly installed PV power plants in 2020 61
Figure 3.3. Challenges for renewable growth in Turkey 66
Figure 3.4. The furniture manifacturers renewable energy cooperative solar power plants generation, 2019-2020 (kWh)..... 75
Figure 4.1. Yalova province central district global radiation map 85
Figure 4.2. Yalova province central district daily radiation values according to months (Kwh / M²)..... 85
Figure 4.3. Satellite image of YASKİ wastewater treatment plants SPP project site area 87
Figure 5.1. Requirements for community energy planning in decentralization policies 94

LIST OF SYMBOLS AND ABBREVIATIONS[1]

DNV GL	Det Norske Veritas (Norway) and Germanischer Lloyd (Germany)
EMBER	Formerly Sandbag or Sandbag Climate Campaign, is an environmental non-profit think tank
EPDK	Energy Market Regulatory Authority *Enerji Piyasası Düzenleme Kurumu*
ETKB	Ministry of Energy and Natural Resources *Enerji ve Tabii Kaynaklar Bakanlığı*
FIT	The Government-Sponsored Tariff Feed *Devlet Destekli Tarife*
GDP	Gross Domestic Product *Gayri Safi Yurtiçi Hasıla*
GHGs	Greenhouse gases *Sera gazları*
GWh	Gigawatt hour *Gigavat saat*
ICESs	Integrated Community Energy Systems *Entegre Topluluk Enerji Sistemleri*
IEA	International Energy Agency *Uluslararası Enerji Ajansı*
IEC	International Electrotechnical Commission *Uluslararası Elektroteknik Komisyonu*
IPCC	Intergovernmental Panel on Climate Change *Hükümetlerarası İklim Değişikliği Paneli*
IRENA	International Renewable Energy Agency *Uluslararası Yenilenebilir Enerji Ajansı*
kWh	Kilowatt hour *Kilovat saat*
MGM	The Directorate General of Meteorology *Meteoroloji Genel Müdürlüğü*
Mtoe	Million tones of oil equivalent *Milyon ton petrol eşdeğeri*
MW	Megawatt *Megavat*
OECD	Organisation for Economic Co-operation and Development *Ekonomik İşbirliği ve Kalkınma Örgütü*

[1] Turkish explanation is in italic.

PCM	Pairwise Comparison Matrix *İkili Karşılaştırma Matrisi*
PV	Photovoltaic *Fotovoltaik*
RE	Renewable Energy *Yenilenebilir Enerji*
RHI	Renewable Heat Incentive *Yenilenebilir Isı Teşviki*
SECs	Sustainable Energy Communities *Sürdürülebilir Enerji Toplulukları*
SPPs	Solar Power Plants *Güneş Enerji Santralleri*
TEİAŞ	Turkish Electricity Transmission Company *Türkiye Elektrik İletim A.Ş.*
UNEP	United Nations Environment Programme *Birleşmiş Milletler Çevre Programı*
UNFCCC	United Nations of Framework Convention on Climate Change *Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi*

CHAPTER 1

INTRODUCTION

The thesis study that investigates several applications of renewable energy for Turkey's local governments and aims to propose to be part of urban policies will be introduced in a way that includes background, scope, methodology and the limitations of the research.

1.1. Background

Energy has become an indispensable resource for human beings with the Industrial Revolution. The main areas of energy consumption include residences, businesses, the transportation sector, and industrial uses. As time goes by the population grows, the world becomes more digital, globalization continues to trigger and public consumption habits containing energy demand is also increasing. Each generation needs to be more focused on consumption than the previous generation. We use more tools and cars and with the growth of megacities and the increasing wealth of rich countries, consumption is rising up in all dimensions. This means that the energy resources used to produce energy are also used more than ever. There are industrial elements in all societies which require energy and material resources. The preference problem determined by traditional economics defines that resources are limited and needs are unlimited. Throughout history, the rate of concentration in resource use has been higher than in population. In short, we've been consuming more than the Earth can produce every year.

While coal, oil and natural gas, which are called fossil energy resources, are the most frequently used resources in energy production, with the oil crisis in 1973, trust in these resources started to decrease and the need for more sustainable energy sources has began. Many countries haven't got fossil fuel sources and requiring them to import which is economically burdensome. Also, burning of those conventional fuels is the main responsible for the increase in carbon dioxide rates in the atmosphere. Thus, the

carbon emissions will inevitably rise if the increasing energy demand is met with the current energy resources portfolio. It causes warming of the atmosphere due to the greenhouse effect it creates and affects all conditions of human life as a result of climate change. Today, the climate-changing greenhouse gas emissions originate from electricity and heat generation, it seems clear that the energy sector need undergo a change in the exit from this crisis. The cost of renewable energy sources is decreasing with the support of developing technologies and storage activities, and their competition with fossil fuel-based energy production is increasing. At this point, the use of clean energy resources has turned into a worldwide topic in the energy sector and significant structural changes called "energy transition", "zero waste" have started to gain importance. There are some energy transition solutions in order to reach the target of Paris Agreement that keep the temperature of Earth below 2, ideally to 1.5 degrees Celsius to stop irreversible global warming. It is stated that 90 percent of decarbonization solutions in 2050 will be provided by renewable energy directly through the supply of low-cost electricity, efficiency and green hydrogen (Gielen, 2021).

Despite the increasing use of renewable energy and natural gas resources in electricity generation, coal is the second largest fuel in the primary energy mix after oil. One of the reasons for this change in coal demand is the closure or replacement of coal plants in the OECD area. In addition, more efficient renewable energy technologies come to the forefront by giving priority to carbon reduction strategies in developing regions. These technological developments are expected to change the energy mix and the administration of public policy regarding energy demand and supply. According to the international report of IEA, renewable energy sources will meet 80% of the increasing power demand in the next 10 years. It is stated in the report that dropping investment costs make it more advantageous to invest in solar power than coal and oil consumption in many countries. While the cost per kWh of solar power was 38 cent in 2010, it has dropped to 6 cents now (IEA, 2020).

The research published by EMBER which is an independent think tank that prepares climate and energy studies, shows that there is an increase in the emission data of the electricity sector compared to 2015, while there is a record decrease in coal production in 2020. (Jones, 2020). Although China is a leader in renewable energy, it resisted this

downward trend in coal production during the epidemic and became the country with a large increase in both electricity demand and coal in 2020. However, the European Union countries took a joint decision to cut support for these coal power plants within the framework of transition to clean energy. At the end of January 2021, the foreign ministers of EU countries made a joint statement that fossil fuel subsidies should be stopped. Korea, Japan, China, the European Union and the UK, which account for more than 40 percent of the world's gross national product and carbon emissions, have announced their targets to reduce carbon emissions to zero. Thus, the trend towards cleaner energy sources from fuels such as coal has accelerated.

Also, the European Commission published the investment program aiming to render the continent harmless to the climate by 2050 with the framework of the "Green Deal" (EU Commission, 2019). Accordingly, the investments required to achieve the climate targets will be further supported by the EU. The EU aims to reduce carbon emissions to a minimum until 2050 and to balance the remaining emissions with various measures and to transform into a continent that does not harm the climate. Due to this fuel tendency, it is predicted that the demand for the products and services of renewable energy companies will also increase. Companies operating in the industry, raw material and technology sectors, which will play a critical role in accelerating this energy transition, attract the attention of investors. These cost advantages also have a major position in highlighting private sector investments of renewable energy.

When many infrastructures were destroyed in Europe after World War I, the private sector was cautious to renew investments. On the other hand, local governments and citizens' cooperatives acted to rebuild the electricity infrastructure in their regions. Although not officially recognized at national, the community energy gained importance from the 1970s, and wide over at last ten years. Today, with applicable technologies and cheaper costs, the communities in the world have opportunities to meet their own energy needs. To ensure renewable energy for the cities, many local governments also have rights to regulate and manage under their responsibilities in order to strengthen the autonomy with the financial opportunities that increase with sustainable production. This is expressed as a way in which decentralization can be activated, where the people can have “a word to say” from the production to consumption of energy, and an exit from the dominant model with the right

technologies and financing. Today, there are examples showing that it is possible to stimulate local economies, create jobs and a livable environment with local resources, as in the past.

Renewable energy cooperatives can also be examined in this context which is formed by citizens' gathering contribute to the creation of social benefit at the local level while producing fair, clean and local energy. Cooperatives form the basis of energy democracy by supporting the production of energy where it can be consumed, the control of energy by local communities, and sustainable local development. Citizens can start investing in energy projects in their communities, often as part of a cooperative or other joint plan in the examples of the world. It is aimed to strengthen the local communities economically and socially with the renewable energy power plants established in the Community Energy method. In addition, renewable technologies are capital-intensive investments and the practices for community energy can ensure a fair distribution of these costs. Because of the community-oriented, fair, based on efficiency and trust, the local renewable energy projects have a positive impact on local development.

Nevertheless, the demand-oriented decentralization can be prevented or postponed by centralized or completely transferred energy applications to the private sector. With the difficulties in terms of legislation, financing and expert employment in Turkey, there are cases where the transition to renewable energy is applicable for private sector investors rather than local applications. Therefore, although steps are being taken to reach consensus on an international scale such as Paris Agreement, the applicability and continuity of the agreements alleged to have been achieved can be debatable for every country.

While many developed countries still meet a significant part of their electricity production with coal-based power plants, many countries are building new power plants. Turkey is also a country that has a large amount of foreign debt, has a serious foreign trade deficit every year, has paid billions of dollars per year. One of the reasons for the increase in this foreign trade deficit is expressed as meeting more than 90% of the oil and natural gas needs through imports. It is seen that Turkey's current account deficit in 20 years covering the 2000-2019 period is 581.7 billion dollars and its net

energy imports (import-exports) are 583.1 billion dollars, and the largest share in this is oil and natural gas (TSKB, 2020). In Turkey and similar countries, the biggest responsible for the external deficit is shown as energy imports. Another element of the external deficit arising from electricity generation is the use of imported coal, which has increased rapidly in recent years. Imported coal power plants, in addition to increasing the foreign trade deficit, also cause irreversible damage to the social and natural environment. Even so, almost 60 percent of the current electricity production in Turkey is derived from fossil fuels. In the monthly installed power reports published by Turkey Electricity Transmission Company (herafter TEİAŞ), the top five rankings on the basis of resources at the end of July 2021, natural gas is 30.02 percent, hydro is 20.15 percent, renewable (geothermal, wind, solar, waste and biomass) 18.54 percent and lignite is 12.79 percent and imported coal ise 16.40 percent. As of the end of July 2021, the part of solar energy in electricity generation was 7.36 percent; wind was 10 percent and geothermal was 1.68 percent (TEİAŞ, 2021).

Also, on the Turkey section of the EMBER report, 12 percent of electricity production provided by solar and wind energy installations in 2020. However, the electricity production from coal fell from 38 percent in 2015 to 34 percent in 2020 worldwide, the part of coal in Turkey rose to 34 percent from 29 percent in the same period. Turkey's coal production increased 39 percent in 2015, 2020 was the second largest increase among the G20 countries (Jones, 2020). In addition, the capacity mechanism payments paid to coal, natural gas and hydroelectric power plants that we import, reach billions of Turkish liras. The total amount to be distributed in the capacity mechanism in 2020 has been increased to 2.2 billion liras (US$ 265 million). In 2020, 9,790 MW of the power plants that benefit from the capacity mechanism generate electricity from natural gas, 11,616 MW from coal and 1,666 MW from hydraulic sources (TSKB, 2020). TEİAŞ makes payments to certain power plants every month within the framework of capacity mechanism support.

In Turkey, while renewable energy gains strength with large-capacity investments, the power plants using such as coal, natural gas have a large share in the energy mix. Large generators produce power, which is then transmitted and delivered to passive consumers. However, the economic efficiency of renewable energy forms seems highly dependent on the organization of social and economic life into smaller units

and decentralization. Considering Turkey in particular, the current regulations often do not fit to the circumstances of community energy applications such as energy cooperatives. While business models for private sector investment are becoming clearer by the financial sector, regulators, industry and even national governments, this creates a policy gap as there is insufficient knowledge or recognition by the government or regulators for the energy cooperatives. The increase in the installed capacity of Turkish renewable energy is a positive development however it is stated that important policies are needed for the transition of the energy sector. In addition to the enhancement use of coal and natural gas, local governments are less involved in renewable energy applications when it is compared with the private sector investments.

When community energy is considered as a part of urban policies in Turkey's local government system, it has been determined that it is on the agenda for purposes such as reducing energy costs, generating income through the sale of excess production to the grid, or meeting climate targets. It has been observed that the practices in different countries are strengthen by the support mechanisms, national enabling frameworks, the increase in the number of participants and local energy activism.

1.2. Aim of the Thesis

This thesis aims to determine the needs of local governments in the light of the discussions mentioned above and the current conditions of the renewable energy sector in Turkey.

To study the legislation and economy of energy projects in local, the research is related to empirical research in the community energy applications. The energy cooperative practices, which are also one of the significant examples of community energy, were also examined through interviews with authorized people.

In the last section of the thesis, it concludes the study and briefly explains the performed efforts and results. Additionally, some recommendations are given in that chapter.

1.3. Research Methodology

Various methodologies were conceptually combined: literature review, analysis of the policy documents, news and semi-structured interviews, and group discussions. For the literature review, the reports, academic publications, and news of national and international institutions and organizations were included in the research.

For this study, the sources are used from different disciplines, such as:

Legal Texts: Laws, regulations, policy documents, and tariffs

Energy Statistics: Historical and categorized energy demand and supply, consumption, and projection figures including fossil fuels and renewable energy sources from Turkish and global sources, global declarations about renewable energy, environmental and sustainability issues

Interviews: With energy specialists, representatives of the local governments and civil society.

The first focus was on the development process of the energy sector after the industrial revolution. The dependency on fossil fuels and the practices that lead to the destruction of the environment were examined from the international reports, energy news and interviews. In energy section of Turkey, energy news, interviews, articles and official newspaper publications were examined in 2019-2020. The renewable energy sector entered its development process with the 2010s and the legislative process from public institutions and literature was examined until 2020. Also, some of the reports were published in the first six months of 2021 and included data from the previous year.

Interviews were held with three different energy cooperative managers and four different municipal officials. The research subject has been examined with the opinions of clean energy experts who are carrying out similar energy projects. The common points were identified in these interviews and similar challenges and issues were addressed for the implementation in community energy at the local. They linked to regulations, the influence of established market actors, and financial limitations. In addition, a case study about a solar energy project that was made with the union of the municipalities was examined in detail as a result of one of the interviews. (Table 1)

Table 1.1. List of relevant interviewees[2]

Number Of Interviewee	Name Of 2.	Gender	Name Of Institution	Organisation Type	Role Of Interviewee	Experience (Years)	Selection Criteria For Widespread Representation
Interviewee-1	E.S.	Male	The Furniture Manufacturers Renewable Energy Cooperative	Energy Cooperative	Manager	29	Director of Turkey's first renewable energy cooperative.
Interviewee-2	O.K.	Male	Troya Environmental Association	Civil society + Energy Cooperative	Chairman	12	Troya Environment Association carries out renewable energy activities with the projects it carries out and the publications it prepares. Troy Renewable Energy Cooperative was founded by 3 women entrepreneurs, is one of the first energy cooperatives in Turkey.
Interviewee-3	S.D.	Male	Citizen Energy Federation of EU (REScoop.eu)	Federation	Project Manager	6	An official who carries out projects on off-grid energy systems, decentralization and community energy applications in the EU.
Interviewee-4	T.P.	Male	The Energy Village of Wildpoldsried	Energy Community	Member of the Municipal Council	36	Electronic engineer, 30 years director and owner of a software company. Since 2015 engineering office and consultant.
Interviewee-5	B.Ç.	Female	Denizli Bozkurt District Municipality	Municipality	Mayor	7	Municipality official who bring the first solar energy projects to life in the district.
Interviewee-6	G.Ö.	Female	Gaziantep Metropolitan Municipality	Municipality	Project Specialist	6	Project Specialist for Environmental Engineering Technology of Municipality.
Interviewee-7	Y.B.	Male	Yalova Municipality	Municipality	Municipal official	12	Electrical-Electronics Engineer of Municipality.

[2] The name of interviewees can not be disclosed due to the thesis ethics consent agreement.

In the study, the method of in-depth interviewing was used to get clear opinions and intimate thoughts of local governments and authorities for the main subjects of community energy applications. The in-depth interview technique involves asking questions and listening. Interviews were conducted in the form of e-mail, telephone, video meeting and face-to-face meeting. There are answers given to questions in a semi-structured way. Semi-structured interview method of in-depth interview technique was preferred because it is a flexible method that allows the participant to express their personal experiences, perspectives and thoughts on a topic in their own words. With the semi-structured interview, interviews were conducted with certain topics or questions prepared beforehand. Questions are asked in order to learn the participant's thoughts, views and point of view. The interview technique used for the preparation of this thesis is one of the most used and most basic data collection techniques in qualitative research. Some of the research questions that were used in interviews:

> How can the renewable energy applications be more implemented by the local governments? Why would Turkey need to plant renewable energy projects in local? What is the relationship between climate change and community energy practices? What challenges are there in meeting community energy practices and local climate commitments together? How to collaborate with the other local institutions- NGOs, cooperatives or private companies? etc.

During the interview, changes were made such as the order of the questions, the way the questions were asked and added.

1.4. Scope

Within the scope of this thesis, this study aims to determine the obstacles and bring policy recommendations for local governments about the electric production from renewable energy resources, especially in solar energy case.

1.5. Organization of the Thesis

The Introduction Chapter provides background information about population growth, consumption patterns that cause a rise in energy demand with the environmental and economic problems triggered by the climate crisis.

The second chapter is the main focus of the study and “Importance of Renewable Energy and Social Evolution” has include “Renewable Energy Outlook, Decentralization Policies and Energy Planning and Energy Communities in the World”. Some factors such as population growth, high rate of increase in energy demand, the growing matter of energy supply security and change in global or regional climate patterns have started a favorable period for affordable renewable energy technologies. Within the scope of this chapter, increasing use of renewable energy resources from local to general and the past and present of local studies are examined in order to provide energy from sustainable and clean energy sources. The historical development of electrical energy, which started with local efforts and then transferred to the central government and turned into a private sector service item all over the world, can emphasize highly centralized and homogeneous policies under the emphasis of localization. The focus of the theoretical and practical discussions on decentralization is the local service and the effect of the center on the resources in the financing of services, and the lack of an independent resource opportunity for local governments. Community energy applications are examined in this section with the view that the commercial space opened by privatizations can offer local governments a way to access demand-driven, cost-effective, and clean energy. So, the decentralization policies and energy planning in different countries were examined for the community energy practices. In the transition to local energy systems, it is accepted that there is no common legislation, economic opportunities, or motivation to advance demand-oriented localization and that the practices include regional differences and activities for community energy are compared. It has been observed that the practices in different countries are supported by support mechanisms, national enabling frameworks, the increase in the number of participants, and local energy activism. To study the legislation and economic effects of projects in local, second part also includes the expert opinions from REScoop.eu and the Energy Village of Wildpoldsried for the community energy applications.

In the third chapter “Renewable Energy Related Local Activities in Turkey” discusses Turkey’s history of the electricity market and current situation within the energy mix and renewable energy. The chapter includes “Development of Renewable Energy in Turkey” and practices part called “Community Energy in Turkey”. When community energy is considered as a part of urban policies in Turkey's local government system,

it has been determined that objectives such as reducing energy costs, generating income through the sale of excess production to the grid or meeting climate targets. Renewable energy transition is progressing to the extent however when it is compared the capacity of private sector investments with the capacity of community energy projects, it has been determined that the issues of legislation, financing and expert employment pose challenges for local practices in Turkey. In this chapter, Turkey's first renewable energy cooperative activities "Furnishers Renewable Energy Cooperative" in Kayseri has been discussed. In this energy cooperative, although the cooperative was established later from other cooperatives, the roof-top solar power plant is the first activity of its kind in Turkey. Furthermore, Troya Environmental Association in Çanakkale, Denizli-Bozkurt & Gaziantep municipalities are at the center of the target of reducing energy-induced carbon emissions with local practices for renewable energy sources, primarily for industry, commercial and residential use.

The “Renewable Energy Related Local Activities” is the fourth chapter of the thesis a case study called Yalova Wastewater and Sewerage Infrastructure Operation Association (YASKI) Solar Energy Project which is a union of municipalities, has been examined in detail from the installation process to its production and financial studies. The information is given by as a result of the interviews from Yalova Municipality. According to the case study, the investments of local governments in this field have developed with the decrease in renewable energy costs and the support provided by Iller Bank. Due to the lack of renewable energy practices in public institutions, local governments in particular have increased their investments in solar energy which are rapidly developing technological developments as an alternative to high energy bills. For the local governments of Turkey generating electricity to meet their own consumption and making it from clean and cheap sources remains in the background compared to exemplary practices in other countries. The frequency of economic crises in Turkey can interrupt the trend towards renewable energy sources. The government supports for decentralization may lag behind private sector investments when it comes to energy planning. These evaluations point to the conclusion that local governments do not have sufficient resources and regulations to fulfill their roles.

In the conclusion, there is a section of recommendations for local and national renewable energy policies and further academic studies in Turkey. In recent years, when the renewable energy has become widespread, many local governments have undertaken important projects in the fields of electricity production, energy efficiency or agricultural irrigation. When community energy is considered as a part of urban policies in Turkey's local government system, it has been determined that objectives such as reducing energy costs, generating income through the sale of excess production to the grid or meeting climate targets are on the agenda. Within the scope of the study, the transition to local energy systems, it is accepted that there is no common legislation, economic opportunities or motivation to advance demand-oriented localization and that the practices include regional differences, and activities for community energy are compared. However, the diversified models enable citizens to be a part of clean energy applications especially in solar energy plants. Because, the wind energy comes to life in larger projects due to the economy of scale; biomass and geothermal require local resources to be available. It seems that solar energy is at the top of both small and large-scale projects for local governments. It has been observed that the practices in different countries are supported by support mechanisms, national enabling frameworks, the increase in the number of participants and local energy activism. For this reason, these efforts to make renewable energy use locally effective seems not only for energy production; it also constitutes a road map of sustainable urbanization with renewables. The concept of localization, which is stated to include all of the political, administrative and social activity areas of the society in certain ways, includes renewable energy applications in urban policies.

1.6. Limitations

The assumptions of the study are stated in as follows: There are different applications of community energy in local administration system of Turkey: For reducing energy costs, generate an income through the sale of excess production to the grid or meet climate targets. The topics of renewable energy and climate change are taking place in the mainstream media, central and local government policies as popular topics in Turkey as well as all over the world. However, in the transition to local energy systems, it is accepted that there is no common legislation, economic opportunities or motivation to advance demand-oriented localization and that the practices include

regional differences and activities for community energy are compared. Despite the increasing interest, it has been determined that community energy is not functionally working in Turkey due to difficulties in implementing the legislation, financial barriers, and the lack of renewable energy experts working in local governments.

Nevertheless, the results of this study contain two main limitations that could be examined in further research. First, the main focus is on the community energy applications that local governments are involved in or are trying to develop, not all renewable energy projects. Second, it addresses solar energy systems because there is no shortage of resources and they do not require large-scale technical investments. This study will not be generalizable to all areas of renewable energy and all energy projects of the local governments. Thus, the research method decreases the generalizability of findings.

CHAPTER 2

IMPORTANCE OF RENEWABLE ENERGY AND SOCIAL EVOLUTION

In this chapter, "Evolution of Renewable Energy and Social Evolution" will be covered mainly including the topics on "Renewable Energy Outlook", "Decentralization Policies and Energy Planning and Community Energy in the World". The global context about energy demand, supply and investment are discussed in the renewable energy outlook part. In that section, global declarations on the renewable energy resources were included in accordance with climate change, environment and sustainability. Some factors such as population growth, high rate of increase in energy demand, the increasing importance of the security of energy supply and change of climate have started that a favorable period for affordable renewable energy technologies.

Through this chapter, it has been also expected to understand how local governments evaluate renewable energy applications with the scope of decentralization policies and energy planning, on legal, and institutional basis. As it can be seen on the Figure 1 below, globalization; corresponds to a complex process that has economic, social, political, cultural and spatial dimensions and all of these phenomena turn into an international structure. However, characterizing globalization as an inevitable result of development makes the pressure and threat it creates on national and local development invisible (Şengül, 2009).

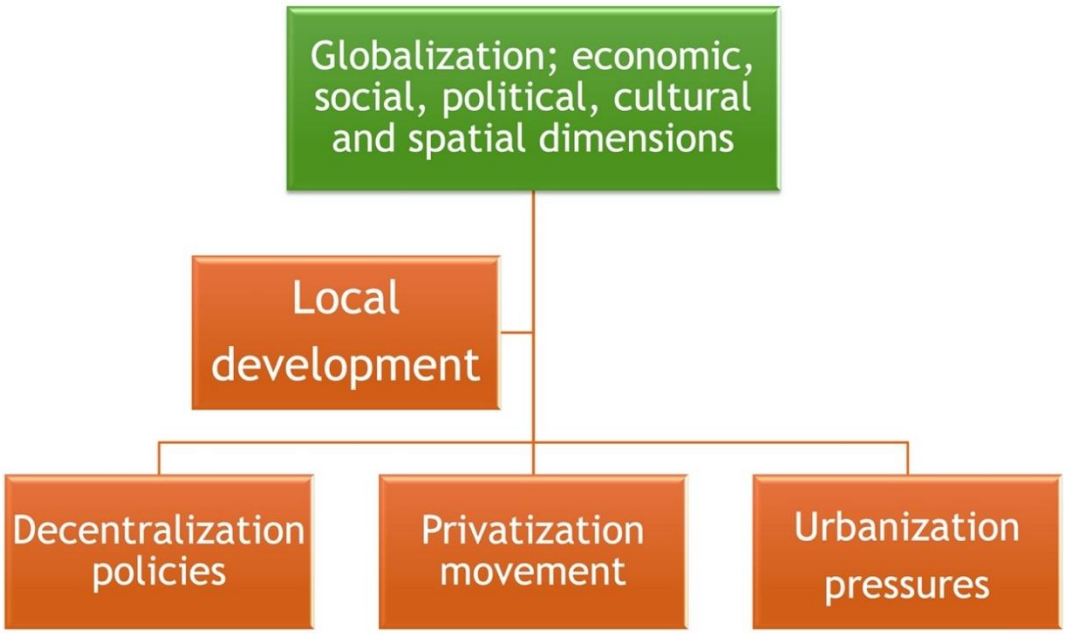

Figure 2.1. Approaches for energy communities

Some reviews points out that neoliberal approach has built the relationship between globalization and localization through the increase in the local's access to larger markets in the process and thus benefiting from the advantages of competition and cooperation. Therefore, these two concepts, which seem fundamentally opposite to each other, are considered as two separate processes coexisting with each other. It is claimed that localization and privatization policies tend to spread around the world. While privatization gains a general prevalence, it can be said that the localization process also affects local governments within this framework (Özel, 2007).

It is stated that there are pragmatic, ideological, commercial and populist forces and pressures that force the privatization movement. While the goal of pragmatists is to establish a better state in terms of being more cost effective; The ideological approach aims at a state with a more limited role than private institutions. Business interest groups seek to do more with more government spending directed towards them; On the other hand, populists aim to reach a better society by giving people more power to meet their common needs and by reducing the power of large public private sector bureaucracies (Özel, 2007). We can state that the last approach mentioned includes practices that include democratic participation such as community energy and that will trigger local development.

In some reviews while traditional policies focus on financial supports and incentive packages to attract economic activities, local economic development can try to avoid such activities and to improve the basic conditions of the region in order to attract and develop economic activities in the future (Rodriguez-Pose, 2001). Here, there can be traces of an economic and environmental local studies on energy with decentralization planning.

In second chapter, reflections of renewable energy regulations on local governments have been elaborated through the interviews and the ways to solve the problems such as financial and specialized employment of community energy and renewable energy regulations has tried to be figured out with the suggestions and recommendations of administrators. Community energy practices, which are increasing as one of the most equitable and social ways for local governments to use energy resources, will be examined in this section. Interviews in this section are consist of the comments of representatives from Europe regarding the practices in the World.

2.1. Introduction

Despite regional differences, the demand for energy is increasing worldwide, depending on resources such as population growth, finance, and technology. It is predicted that this increasing trend will continue in most of the analyzes for the future of energy. Global energy demand reached its highest level in the last decade. A growth of 2.3 percent was recorded due to the strengthening global economy and increasing population, increasing demand for heating and cooling in developing regions such as Middle East & Africa, Other Asia as can be seen from Table 2.1

Throughout history, the rate of concentration in resource use has been higher than in population. Each generation is more focused on consumption than the previous generation. We use more tools and cars and with the growth of megacities and the increasing wealth of rich countries, consumption is increasing in all dimensions. Each of us is consuming our resources at an ever-increasing rate and producing waste at an increasing rate. This means that the energy resources used to produce energy are also used more.

Table 2.1. World population growth, 1993-2019 versus 2019-2045 (millions)

	1993-2019	**2019-2045**
OECD	209,28	77,56
Middle East & Africa	522,26	788,99
India	439,01	254,20
China	214,97	-4,47
Latin America	130,14	71,85
Other Asia	393,66	292,51
Rest of the World	220,40	287,88

Source: United Nations, OPEC (2020)

The effect of this cycle is now clearly manifesting itself as a climate crisis: the atmosphere and oceans are warming, and as a result, the ice sheets at the poles and the glaciers on the mountains are melting. On the report of the Intergovernmental Panel on Climate Change (IPCC[2]), it is a small chance that the world can limit temperature of the Earth to 1.5°C and even 2°C unless countries manage to reduce gas emissions causing greenhouse effect immediately. (IPCC, 2021). It is highlighted in the report that climate change will increase in all regions of the world in the upcoming period with more heat waves, longer summers and shorter winters as a result of the 1.5°C increase in global temperatures. It is also stated that a global warming of 2°C will cause critical points to be reached more frequently in agriculture and health. However, IPCC states that a determined and sustainable reduction of greenhouse gases may restrict the warming (IPCC, 2021).

At this point, the main waste produced and built in every field from transportation to industry is carbon dioxide. Oil, coal, gas, nuclear, hydro, biowaste and solar and wind are the basis of the world energy mix. Some of them consist of fossil fuels used for heating, transportation and electricity generation since the industrial revolution. After the 1973 oil crisis to maintain the stability of international oil supply. IEA was founded by 17 founding countries (including Turkey) after the 1973 oil crisis, and today it has 30 members. Today, IEA is no longer just involved in the fossil fuel system, but also provides forecasts and recommendations on key players in energy transition, such as renewable sources, efficiency, and technology. Taking a generally cautious stance on

[2] IPCC is the United Nations part for valuation the science related to climate change and founded in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). The aim of the IPCC is to provide governments at all levels with scientific information that they can use to develop climate policies. UN General Assembly approved the establishment of IPCC the same year. IPCC has 195 member countries. Thousands of scientists around the world contribute to IPCC Assessment Reports.

climate change, the IEA's call in a new report to immediately ban the development of new investments in new fossil fuels is considered an important development. Even if the climate commitments made by governments to date are fully realized, it remains difficult to do what is necessary to bring global energy-related carbon dioxide emissions to net-zero by 2050. The report proposes a clean, dynamic and resilient energy economy dominated by renewable resources (IEA, 2021:1).

Today, more energy think tanks mention that the only way to prevent energy resources, food and raw material production from reaching the limit is to reduce carbon dioxide emissions. Carbon dioxide, which causes warming of the atmosphere due to the greenhouse effect it creates, affects all conditions of human life as a result of extreme weather events. While the intense greenhouse gas production from richer economies affects poorer societies more, these peoples in underdeveloped economies are also exposed to the consequences of environmental disasters. As the world ceases to be a livable place, the destruction that the energy sector has created so far is also coming to light and requires a search for a solution. So, it is significant to determine the problems and solutions to sub-sectors and assets included in power sector investments as can be seen from Table 2.2.

Table 2.2.Sub-sectors and assets included in power sector investment

Sub-Sector	Assets
Fossil-fuel based power generation	Coal-fired power
	Coal-fired power with CCUS (Carbon capture, utilization and storage)
	Gas-fired power
	Gas-fired power with CCUS
	Oil-fired power
Nuclear power generation	Nuclear power plants (greenfield)
	Refurbishments and upgrades of existing plants for long-term operations
Renewable power generation	Bioenergy
	Hydropower
	Wind (onshore and offshore)
	Geothermal
	Solar PV (utility-scale and buildings)
	Solar thermal
	Marine
Electricity grids	Transmission
	Distribution
	Public EV chargers
Battery storage	Utility-scale and buildings

Source: IEA World Energy Investment 2021- Methodology Annex (IEA, 2021:2)

Renewable energy includes many sources and photovoltaic, wind and hydroelectricity are in the foreground. All three sources vary depending on weather conditions and geographic location. There are insights that advocate a gradual transition to renewable energy sources to ensure security of supply in energy on the grid. Scientific research indicates that the world's oil and gas reserves are declining and resource shortages will increase. (IEA, 2021:2) For this reason, it is believed that countries should increase their expenditures on the development and implementation of clean energy technologies. It is stated that advanced storage systems and green hydrogen facilities will be effective in this process and positively affect the security of supply in renewable energy. While fossil fuels are found in highly centralized reserves, the production of clean energy sources are almost anywhere. The global use of these resources may evolve depending on countries developing and sharing green technology, operating power grids across borders, and coordinating transnational energy markets (IEA, 2021:1).

The 2021 Global Energy Perspective report prepared by McKinsey & Company reinforces the view that renewable energy sources will probably replace fossil fuels. According to the 2021 Global Energy Perspective report prepared by the Us-based management consultancy company, McKinsey & Company, solar and wind power will dominate the global energy industry in 10 years as solar and wind power plants will become cheaper to install than fossil fuel plants. It is stated in the report, solar and wind power plants will account for almost half of the electricity by 2035, and cost competitiveness in hydrogen technologies running on renewable energy will be another game-changer by 2030. According to the report, global demand for coal power has already peaked, and it will do so for oil in 2029 and for natural gas in 2037. The report forecasts that all fossil fuels will reach a record high in 2027. The report also considers four energy scenarios and estimates that the world has drifted away critically from the temperature rise upper limit of 1.5°C set for this century. It is estimated in the report that the world would consume the carbon budget of 2100 already in the early 2030s. It is also estimated that electric vehicles (Evs) will become the most economical option in many parts of the world within the next five years (McKinsey & Company, 2021).

Some other research shows that despite the rapidly developing electrification, natural gas and oil will not leave their peak places easily. In the World Oil Outlook report published in 2020, Organization of the Petroleum Exporting Countries (hereafter OPEC) announced in 2045, oil will provide 27% of the energy used in the world, 25% of natural gas and 20% of coal. Solar, wind and geothermal, which are called other renewable resources, will grow by an average of 6.6 percent on an annual basis. It is stated that natural gas is the fastest-growing fossil fuel between 2019 and 2045 and will make the second-largest contribution to the energy mix with a 25 percent share in 2045. There was a significant decrease in the annual 4.5 percent growth rate seen in the last 10 years in coal demand and an increase of 0.7 percent was recorded last year. On the other hand, coal-based electricity generation continues to account for 30 percent of all energy-related carbon dioxide emissions and remains the largest emission producer (OPEC, 2020).

According to the report of OPEC, it is projected that oil will make the largest contribution in the energy mix, after natural gas by 2045. Coal maintains its position in the second place of the global energy mix but many power plants running on coal around the world is replaced by renewable energy and natural gas. Coal demand is expected to fall by 0.3 percent on a yearly basis. This is attributable to two main factors: The first is the shutdown and replacement of the coal plant in the OECD area. Second, more efficient energy technologies have emerged that prioritize decarbonisation. Despite the decline, India's demand for coal is expected to rise by 2.6 percent from 2019 to 2045. In other parts of the report, it is expected that technological developments will shape global energy environment, and public policies on energy demand and supply will become stricter. China, USA and India continue to be the leading countries in the increase in demand as indicated on Table 2.3. (OPEC, 2020). In addition, developing countries with growing populations and high economic growth play a key role in increasing energy demand (OPEC, 2020).

Table 2.3. Distribution of the global economy, 2019 and 2045 (%)

	2019	**2045**
OECD Americas	19,15%	15,05%
OECD Europe	17,40%	11,64%
OECD Asia Oceania	6,82%	4,30%
China	19,22%	24,23%
Other Asia	9,78%	11,79%
India	7,98%	15,55%
Rest of the World	*19,64%*	*17,44%*

In particular, some factors such as population growth, high rate of increase in energy demand, increasing importance of the concept of energy supply security and climate change have started a favorable period for renewable energy technologies worldwide as Figure 2.2 shows.

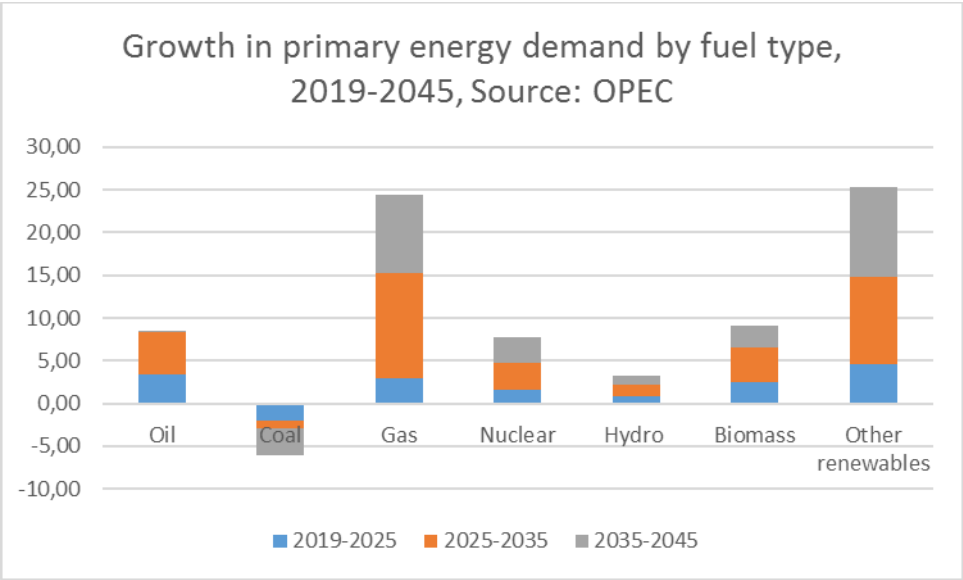

Figure 1.2. Growth in primary energy demand by fuel type, 2019-2045

By 2050, renewable energy and fossil fuels would have an almost equal share in the global energy mix. Although the oil and gas industry remain effective in the current low-price environment, renewable energy will increase its cost performance at a faster rate in the coming years. According to the estimates in the report, solar and wind will together provide 24 percent of global electricity in 2030 and 62 percent in 2050. Also, forecasts show that global energy investments will decrease by 18 percent and global carbon emissions will decrease by 7 percent with slowing economic activity (IEA, 2020). According to the analysis of Bloomberg NEF, renewable power will become

inexpensive using coal and natural gas to generate power within five years. Solar power capacity will increase by 280 gigawatts and grow by 12 percent on a yearly basis until 2030 (Bloomberght, 2020). Clean energy sources will meet 50 percent of global demand in 10 years.

However, today nearly 80% of the energy capacity still comes from fossil fuel and 11% from renewable energy sources. (REN, 2021). With the rapidly developing new technologies such as renewable power generation, electricity grids, battery storage seems to be strong enough to realize this change in terms of potentiality and technique. As a result, in solar and wind projects, which have replaced even the cheapest coal power plants in terms of cost, the development of technology, the economic size, the formation of a competitive supply chain, and the experience of investors in adapting to new technologies have been the main reasons for the decrease in costs. In this period, state-supported investment incentives such as purchase guarantees and large-capacity projects in solar and wind projects, as well as small and medium-sized power plant installations, were implemented in many countries. While this whole process triggeres private sector investments, it strengthened the participation potential of green energy sources and access of societies to clean energy.

2.2. Renewable Energy Outlook

There is IRENA's definition that renewable energy includes all forms of energy produced sustainably from renewable sources, including bioenergy, geothermal energy, hydropower, ocean energy, solar and wind energy. (IRENA, 2021). On the other hand, the IEA defines clean energy sources as “obtained from natural processes” and “renewed faster than consumed” (IEA, 2014).

In the last five years, considerable success has been achieved in generating electricity from renewable energy, but developments in the heating, cooling and transport sectors have been limited. According to the Renewables 2020 Global Status Report published by REN21, energy demand continues to increase on a global scale, while this increase is eroding growth in renewable energy (REN21, 2021). Also, the "Global Future of Renewable Energy 2019" Report, published by REN21, assesses the importance of solar energy, the impact of the heating and cooling sectors, the place of energy in

urbanization policies, and the impact of subsidies, while identifying 12 steps to transition to clean energy (REN21, 2019).

In particular, it is stated that the climate crisis will increasingly continue if the transformation based on efficient and renewable energy does not occur immediately in all sectors. Developed and developing countries lead the countries with the highest energy-related carbon emissions. While the impacts of the climate crisis derive from countries that produce more greenhouse gases, natural disasters such as floods and drought affect societies with less energy consumption more. Research shows that renewable energy as the fundamental source of growth, especially to limit carbon emissions and reduce the consequences of the climate crisis. China, OECD America, OECD Europe, India, and Asian countries which entering the market rapidly are among the economies that should primarily rise clean energy consumption in this sense as seen on Table 2.4.

Table 2.4. Share of energy-related global CO2 emissions (%)

	%
China	30,7
OECD Americas	17,6
OECD Europe	10,4
India	7,2
Other Asia	6,4
OPEC	6,4
OECD Asia Oceania	6,4
Russia	4,8
Middle East & Africa	3,8
Other Eurasia	3,1
Latin America	3,1

Source: Global Carbon Project, Data: CDIAC/GCP/UNFCCC, 2020

On the other hand, power grids would draw a significant amount of investment to ensure that the power generated by renewable resources is properly supplied to the grid. According to the Renewable Capacity Statistics 2021 report, more than 80 percent of the new electricity capacity added all over the world last year came from clean energy sources. Solar and wind energy accounted for 91 percent of this share. The commissioning of fossil fuel power plants decreased from 64 GW the previous year to 60 GW in 2020 (IRENA, 2021).

As seen in Figure 2.2, by the end of 2020, global renewable generation capacity had increased to 2,799 GW. Solar and wind were the two major sources of capacity growth in 2020, with 127 GW and 111 GW of new installations respectively (IRENA, 2021).

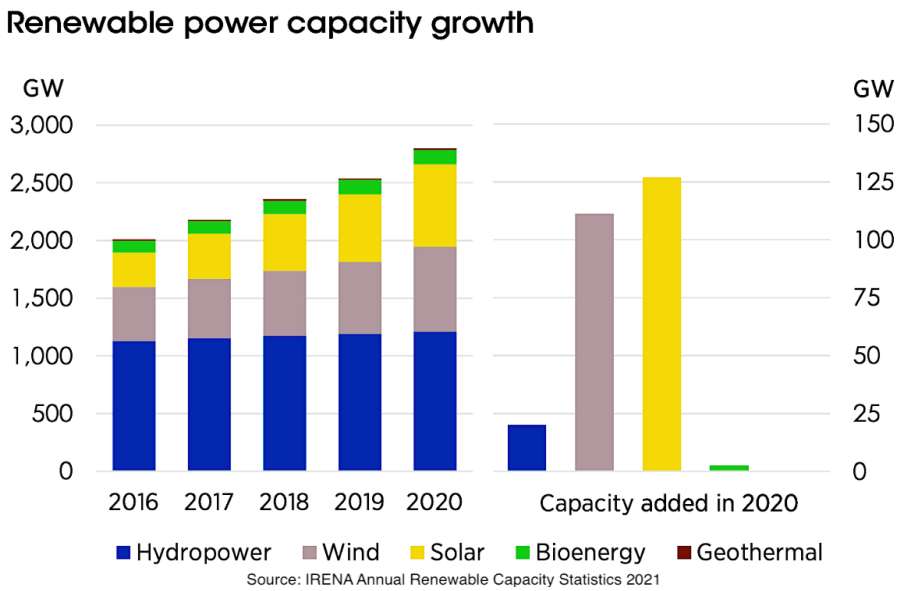

Figure 2.3. Renewable power capacity growth (2020)

It is understood that the global and local developments in the fossil fuel markets bring both risks and opportunities for the whole world. By 2050, natural gas strengthens its place, while green energy technologies also added to the competition. Biofuels and nuclear power are also moving forward, maintaining their share of the global energy mix. While coal has increased its decline with the 2030s, oil demand remains important until the 2035s, when electrification is predicted to increase. Developing storage technologies, falling clean energy costs and the potential of electric vehicles are the main topics of this decline. The main reason for this decline is the accelerating electrification, which shows that the world's energy systems are highly sensitive to changes in energy efficiency. The use of electricity is more efficient than fossil fuels and causes less heat loss. With the addition of more solar and wind energy to capacity than ever before, only insignificant energy losses occur compared to the past, and efficiency increases.

As can be seen in Figure 3, the share of clean energy in global capacity is increasing every year, especially for wind and solar energy. This major share can reach a sufficient level will increase the production capacity, strengthen the integration of the

electricity grid and other consumption sectors; requires the implementation of supportive policies in the social, economic, and technological fields. However, large investments or capacity increases on a global scale may not be a sufficient indicator to use the current pace of development in renewable energy to prevent the negative effects of climate change. What should be emphasized here is to be included in the global effort with the increase in renewable energy applications at the national and local levels. In the following section, the work that can be done in local energy systems will be discussed in order to provide access to energy at the local level and to obtain it from cheaper and cleaner sources.

2.3. Decentralization Policies and Energy Planning

Decentralization, which refers to the transfer of powers and responsibilities from the central government level to local elected officials, also focuses on the relations between the central government and local governments. As Figure 2.4 below shows, decentralization is also a multidimensional concept as it encompasses three different but interrelated dimensions. The political, administrative, and financial dimensions are interconnected, despite the complex nature of urban policies and challenging structures (OECD, 2019).

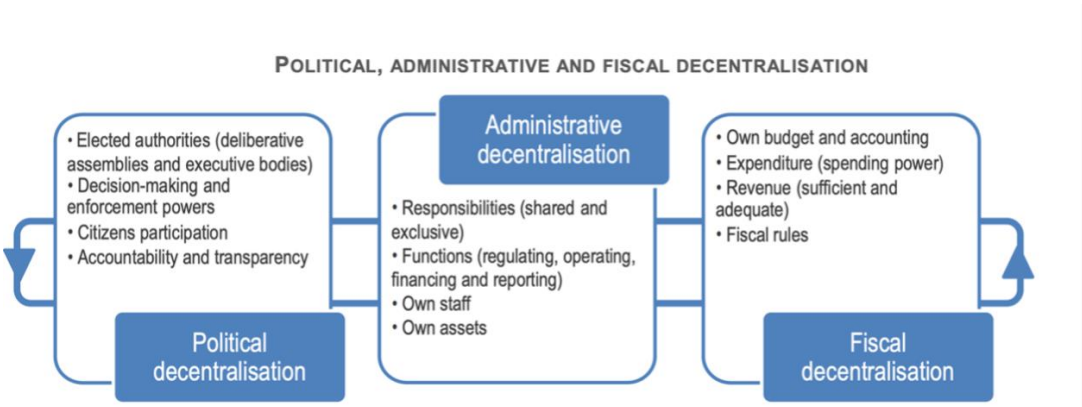

Figure 2.4. Political, administrative and fiscal decentralisation (OECD, 2019)

In order to analyze decentralization policies and the development process of renewable energy projects first requires evaluating the history of local energy production practices and the transformation process. Energy, which was offered as a local service in the past, has turned into large investments within the scope of economies of scale

with the regulations and privatizations. Urbanizing public policies are also transforming into sectoral public policies such as energy. Determining what is suitable for the public interest in a society where there are different interest groups is also a matter of debate (Ersoy, 2016). Due to the multidimensional and complex nature of urban policies; the stance of decision makers in different institutions that tend to produce uncertainty; The need to produce different solutions within the inner dynamics of each city requires a more detailed examination of the challenging structure of urban policies (Bayırbağ, 2017).

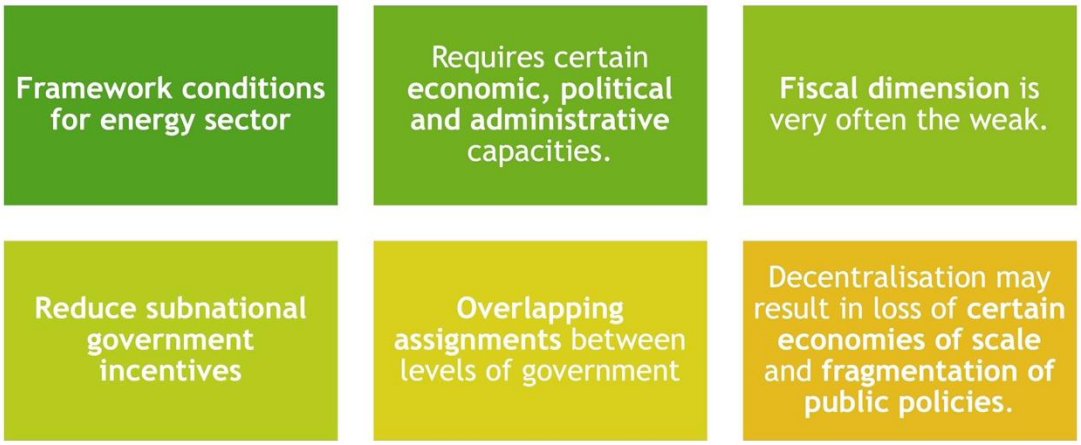

Figure 2.5. Decentralization policies which affecting local energy planning

On the challenging structure of urban policies, there are main Decentralization Policies which also affecting local energy planning (Figure 2.5): First, the central government is responsible for setting the framework conditions that will determine how decentralization systems will work. Decentralization requires certain economic, political, and administrative capacities. The fiscal dimension generally remains weak with high reliance on central government transfers. Another major challenge of decentralization arises from the overlapping tasks between levels of government. Public institutions, the private sector, and non-governmental organizations involved in the energy policy-making process may experience problems in the distribution of duties here. In addition, economies of scale and public policies may be disrupted by decentralization. All these identified characteristics are important for evaluating the development processes of community energy applications. For all these reasons, the local functioning of the energy sector is related to providing a structure in which legislators, the private sector, and other stakeholders should work in a balanced way.

The history of energy infrastructure is based on the centralized model with non-citizen participation. However, the nature of renewable energy resources that allows the public to invest and the fact that their costs have been getting cheaper in recent years have made our need for large energy investments questionable. The "Local energy" concept is considered to encompass "energy projects managed by local actors for local benefit" and is recognized as a significant element in the substitution to a decentralized energy system and a low carbon economy. It provides opportunities to invest in power generation, transmission, supply, and allows the resulting benefits to be realized at the local level, as identified and advocated by community energy agencies alike. Both local and community energy solutions are seen as increasingly important to achieving an affordable, secure, low-carbon future while delivering far-reaching economic, social and environmental benefits. There is a growing voice encouraging local authorities to help realize these potential benefits by partnering with community organizations to create long-term local energy strategies and forward-looking policies to help keep local energy plans afloat (Wilson, 2017).

2.3.1. Approaches For Energy Communities

The history of decentralized energy production systems goes back to ancient times. In the literature review, it is stated that local economies and autonomy will be strengthened with localized energy production and consumption. Accordingly, local energy systems can potentially contribute to energy and climate targets by reducing energy consumption and emission trends.

Today, the state acts as a regulator in energy production and provides incentives by preparing legislation. While private sector investments act according to these regulations, non-governmental organizations also influence the regulations through various activities. Energy activities of this nature are considered as a public policy issue. When energy and local governments are examined together, it is important to determine how this public policy is produced in the political system, how institutions and processes deal with the demands produced in the environment, and which actors are formed.

In order to examine the development process of applications for community energy, it would be appropriate to first examine the history, development, and transformation

process of applications for local energy production. Local governments are the units that produce and implement urban policy with investments that will improve physical and social infrastructure conditions within their areas of responsibility. Today, it is seen that urban policies are gaining more and more importance as a public policy area to find solutions to the new problems produced by urbanization. Urbanizing public policies are also transforming into sectoral public policies such as energy. Determining what is suitable for the public interest in a society where there are different interest groups is also a matter of debate (Ersoy, 2016).

It is important that stakeholders such as the public, private sector, and civil society, who are responsible for explaining how and with which tools the shape of the city will be achieved in the future, can have a say here. However, the multidimensional and complex nature of urban policies; the stance of decision-makers in different institutions that are prone to producing uncertainty. The need to produce different solutions within the internal dynamics of each city, and the fact that policymaking and implementation processes proceed with conflicts rather than harmony require a more detailed examination of the challenging structure of urban policies (Bayırbağ, 2017). It is significant to identify whether central government institutions are monolithic, unified, or stable. Policy adjustments at this point can only be expressed as "temporary stability in a constant flux". (Arts, Leroy and van Tatenhove, 2006). It is also determined by the interests of national governments, competitiveness, and priorities (Creamer, 2018).

Within the scope of this study, urban policy planning, which we will evaluate in terms of the energy sector, is not only a technical and administrative process for local governments, it is affected by political relations and tensions and is not on a fixed level by nature; it progresses through relations and processes and that the problems and solutions produced differ locally (Bayırbağ, 2017). In the capitalist society, which is built on the basic principles of private property and the market mechanism, social relations are shaped based on production-distribution-consumption. According to David Harvey, the built environment is efficient and rational to the extent that it contains a use-value that will facilitate social reproduction and development (Ersoy, 2016).

When we look at the cities where production and consumption are most intense, it is seen that the distribution side is provided through public, private sector, and civil society relations. In the history of energy, there is a structure where energy turns into a profit mechanism rather than public benefit with the increase of urbanization and becomes attractive for private sector investors. We can also examine this situation in the historical development of electrical energy, which started with local efforts and then transferred to the central government and turned into a private sector service item all over the world. As a result of the increasing need to obtain electrical energy and offered to the use of humanity primarily for lighting, new and renewable resources, wind, solar, biomass, and similar resources were started to be evaluated as well as primary sources.

The focus of the theoretical and practical discussions on decentralization is the effect of the center on the resources in local service delivery and financing of services, and the lack of an independent resource opportunity for local administrations (Lienert, 2005). The financial resources of local governments are not from municipalities; The high rate of centralized provision prevents the democratic control of the people over the expenditures and service production for local governments from reaching the desired level of effectiveness (Topal, 2004). One of the most important dimensions of local governments' finances is for the revenues allocated to this level of efficiency. It is understood that income-sharing systems result in very different ways from country to country. It is seen that this emerging income sharing system has developed under the influence of historical and economic factors, as well as differing as a result of the administrative systems of the countries (Sakal-Meriç, 2005).

The most basic subject of public finance, providing services, requires making public expenditures. The relative importance of local governments' finances depends on the sharing of public services between the central government and local governments, and the breadth of resources allocated to local governments. Since local administrations are given wide powers in countries where decentralization is implemented in administrative terms, the relative importance of local administration finances in these countries is great. In centralized countries, a narrow field of activity is reserved for local governments. 40-57% of total public resources are used by local governments in countries such as the USA, Canada, and Germany, where localization and,

accordingly, administrative and financial decentralization is intense. In countries where the central structure is strong, such as France, England, and Turkey, the ratio of local government finances varies between 10-30% (Sakal, 2009).

The issue that should be emphasized here is that policies produced on a national, supra-national, and global scale are increasingly targeting cities, and highly centralized and homogeneous policies are being produced/implemented under the emphasis of localization. Policies implemented in the form of prescriptions operate differently from the classical public policy process, which is formulated as an activity based on "raising the issues, negotiating priorities, making decisions based on empirical analysis of problems and engaging in solutions". (Bayırbağ, 2017) To examine the concept of localization, which is stated to include all of the political, administrative, and social activity areas of the society in certain ways (Keleş, 2000), a close relationship can be established between the concept of privatization and localization within the framework of the globalization trends of our time.

With the acceleration of the globalization trend since the 1980s, the trust in traditional development practices began to be shaken, thus the local economic development approach came to the fore. Globalization; corresponds to a complex process that has economic, social, political, cultural, and spatial dimensions and all of these phenomena turn into an international structure. However, characterizing globalization as an inevitable result of development makes the pressure and threat it creates on national and local development invisible (Şengül, 2009). Şengül defines globalization as “a project imposed by capitalism to overcome the crisis that it has not been able to get out of since the 1970s”. The neoliberal approach has built the relationship between globalization and localization through the increase in the local's access to larger markets in the globalization process and thus benefiting from the advantages of competition and cooperation. Therefore, these two concepts, which seem fundamentally opposed to each other, are considered as two separate processes that coexist with each other. Increasing access to the global market is a positive process that contributes to the development of local communities by using local resources effectively and efficiently. It is possible to follow this understanding in the approaches of international organizations.

After the 1970 Crisis, it is claimed that decentralization policies and the "restructuring" initiatives of other international institutions, especially the World Bank, played a role. This is seen as one of the reasons why the accumulation crisis of capital cannot be overcome by privatization policies only at the national level and privatization practices have become widespread in many developed and underdeveloped countries. Localization and privatization policies tend to spread around the world. In the era of globalization, while privatization gains a general prevalence, it can be said that the localization process also affects local governments within this framework. (Özel, 2007)

It is stated that there are pragmatic, ideological, commercial, and populist forces and pressures that force the privatization movement (Özel, 2007). While the goal of pragmatists is to establish a better state in terms of being more cost-effective; The ideological approach aims at a state with a more limited role than private institutions. Business interest groups seek to do more with more government spending directed towards them; On the other hand, populists aim to reach a better society by giving people more power to meet their common needs and by reducing the power of large public-private sector bureaucracies (Özel, 2007). We can state that the last approach mentioned includes practices that include democratic participation such as community energy and that will trigger local development.

Local economic development is a participatory process with important goals such as creating a common development strategy that supports partnership and cooperation activities between public and private sector actors in a particular region by using local resources and competitive advantages (Van Boekel and Van Logtestijn, 2002). The local public authorities take the leadership role in the planning and coordination of the distribution of services in the region, prepare local strategic development plans, and make compulsory infrastructure investments for the general public interest (Gül, 2004).

As a result of all these, while the importance of the traditional development approach decreased, the importance of local development increased, and this led to the emergence of many new approaches. First of all, it has been suggested that while decisions about regions and regions are taken from the center in traditional

development, a bottom-up decision mechanism should be operated in local development, and cooperation between sectors should be established. Secondly, while a sectoral approach is brought to development in the traditional understanding, the areal approach comes to the fore in the local understanding. Third, most traditional development policies are aimed at realizing large industrial projects, while local policies aim at adapting the local economic system to the changing economic environment. Finally, while traditional policies focus on financial supports and incentive packages to attract economic activities, local economic development tries to avoid such activities and to improve the basic conditions of the region to attract and develop economic activities in the future (Rodriguez-Pose, 2001). There are traces of economic and environmental improvement in local studies on energy planning.

In 1977, Lovins stated that a system based on renewable and small-scale technologies could act unhindered by central bureaucracies and compete for a market share through creativity and local adaptation. Similarly, in 1983, Duedney and Flavin emphasized that a decentralized distributed technology system would be much more dominant locally, and power generation would thus strengthen local economies and autonomy (Hoffman, High-Pippert, 2005). There is a structure in which local communities leave their passive consumerism and transform their traditional identities into both consuming and producing. Local energy systems are considered to potentially contribute to overall energy and climate goals by helping to reverse trends in energy consumption and emissions around the world. (Schoor T, Scholtens, 2015).

Moreover, national policies promoting the decentralization of development planning and service delivery can be used to expand energy access in rural and remote areas, especially if local actors (including local governments, non-governmental organizations and private sectors) can participate and are empowered to participate in decentralized planning processes (UNDP, 2019). Therefore, it is important to first create the institutional policy map to identify the public authorities, semi-public institutions involved in the energy policy process, and the organized (private sector and non-governmental) circles that have a say in the policy process. (Bayirbag, 2013). In the applications for community energy, which will be examined in detail in the Turkey section, it will be analyzed how well the decentralization and privatization

efforts of all these parties involved in energy-related public policies complement each other.

Improving energy service delivery at the local level will require better coordination and accountability mechanisms between national and local institutions and across sectors, as well as empowering local governments to plan and manage energy, and strengthening the capacity of local actors to address energy demand issues (Bomberg, McEwen, 2012). As Hoffman and High-Pippert (2010) suggest, sustainable participation is therefore likely to be motivated by an appreciation of community-wide benefits rather than personal benefit (Creamer, 2018). Where local governments do not take a leading role in the development of energy projects, they can still be key players in partnerships with civil society-led energy projects. Local authorities supported the community energy project through innovative use of municipal resources, including access to buildings to house the solar panels, as well as access to finance, staff and expertise. The political priorities of these local authorities were in favor of community ownership and stemmed from recent enabling forces as well as the councils' background in sustainable development work. Supporting community energy was also recognized as a pathway to local engagement and community responsibility for assets, and a source of opportunity for education, skills development and empowerment, which is important in the face of dwindling council resources (Creamer, 2018).

Recognition of the political context highlights the overlooked dynamics that affect groups, but also enhances our understanding of the current factors – particularly financial and technological – that have been described in the current literature as conditioning community action. Energy transitions are social and political as well as economic and technological transformations (Kalkbrenner-Roosen 2016). As a social phenomenon, we contribute to research on energy transitions. This work helps to understand the principles that underpin the desire to participate in community energy. Increasingly, policy decisions made by national and local governments must be contained within an legal and regulatory framework. Despite this national and supranational policy environment, governments need to maximize their constitutional capacity to promote renewable energy and energy efficiency. They need to design a different program to reduce greenhouse gas emissions that exceed the targets set at higher levels by renewable electricity and local targets (Bomberg, McEwen 2012).

At this point, a close relationship can be established between the concept of privatization and localization, within the framework of the globalization trends of our age, to analyze the concepts of localization and privatization, which we have examined above, in a balanced manner.

2.3.2. Community Energy

Citizen participation and ownership structure are of particular importance in decentralized renewable energy infrastructures. The realization of these renewable energy generation projects is supported by the government to achieve carbon reduction targets while maintaining security of supply. In many countries, support programs play a crucial role in deciding whether community energy is economically viable and helps explain the emergence of national differences (Brummer, 2018).

The Civil Society Dialogue Project named Powering Communities defines Community Energy as follows: "Renewable energy projects can be developed with different ownership models that lead to very different results. There are currently many different definitions for the concept of community ownership around the world. In this project, community ownership focuses on the goal of using the income generated by renewable energy projects for the benefit of the members of the local community. In other words, the main purpose is to provide public benefit, common benefit. In this respect, it differs from commercial ownership models whose main purpose is to generate a private gain." (Powering Communities Project, 2018).

In IRENA's Community Energy Action Coalition Report, community energy is not limited by size, it can occur on both a large and small scale. Community energy is defined as the economic and operational participation of citizens or community members in renewable energy projects. (IRENA, 2018).

According to these definitions, nonprofit cooperatives, municipal companies and community foundations are seen as community ownership. It should be emphasized that renewable energies belonging to individuals are not seen as community ownership. Community Energy empowers local communities economically and socially while maintaining control of the community during the planning, installation, and operation of renewable energy facilities.

Community Energy is a common platform where ordinary people come together for the production, storage and efficient use of the energy they consume every day. Citizens start investing in energy projects in their communities, often as part of a cooperative or other joint plan. Renewable energy systems implemented with the ownership of Community Energy are already underway in many European countries. Cooperatives in many countries contribute to the production of clean energy with the supports provided to encourage energy production from renewable sources.

Especially the oil crisis in the 70s and the changes in energy policies after it, environmental problems, and the parallel increase in energy prices brought together environmentally conscious citizens and encouraged them to cooperate in the field of renewable energy. With the contribution of incentive mechanisms such as the Tariff Guarantee System, renewable energy cooperatives began to be established in developed countries such as Germany, England, and Denmark, as well as Canada, the USA, and Australia.

Among these countries, Denmark is considered to be the country with the strongest renewable energy cooperatives in Europe. Today, more than half of the renewable energy facilities in Germany and Denmark are established as cooperatives, which have a major role in ensuring the participation of the society in the economy and the energy market. The reason for this is the desire of the people of the country, acting with the awareness of social solidarity, to gain their local needs and their own energy independence, not only in these countries but in all countries where renewable energy cooperatives are established. In this way, it has been observed that although there are significant differences in the structure, scale and type of production in terms of renewable energy policies of countries, cooperatives can operate in the energy field without making any difference from other types of companies.

According to Int-4, this was achieved through the close and efficient cooperation between the district and the municipalities, too and explains:

> The citizens were not only convinced in Wildpoldsried, but throughout the Allgäu and encouraged to participate. Everywhere they have invested in local producer companies, which means that the yield has remained directly in the region, which has also reduced resistance to this energy production, which was still uncommon at the time. Participation was the motto. But not only at the municipal level, but also every single household has contributed to the success with intelligent solutions. This was

> particularly promoted by energy trading platforms with which citizens can supply each other with energy without any legal or administrative hurdles. Thanks to distance-dependent network charges, the energy is almost never transported over long distances and is generated and consumed on site as cheaply as possible.

The advent of renewables is reshaping the vital relationship between consumers and energy providers to quality of life and one of the best examples of that is Wildpoldsried. The European Union is trying to do more legal studies that will trigger this development. In our interview with Int-3, it has been highlighted that at the end of November 2016, the European Commission made an unprecedented move acknowledging citizens (as 'active customers') and energy communities as legitimate market actors in the energy transition in EU legislation. After 2000, the development of renewable energy cooperatives slowed down due to several legal and economic reasons. The problem here was that if the market for renewables in Europe continues to develop without acknowledging and encouraging energy communities, the energy transition could face major growing issues moving forward. Therefore, the new Renewable Energy Directive proposed in June 2018 may come to mark an important milestone in the energy transition. While before, citizens and communities were unsung heroes -even pioneers- of the energy transition, this directive gives energy communities and citizens not just acknowledgment, but a concrete set of rights and an enabling framework so they can develop at national level.

However, for Int-3, the new Renewable Energy Directive does not solve all problems for renewable energy communities, and indeed there are still a lot of unanswered questions to unpack. Whilst energy communities are now backed by European law, they will still need the support of their national governments to really lead the energy transition to energy democracy. Especially in Europe, positive incentive mechanisms implemented with energy and cooperative policies have been an important driving force for the development of renewable energy cooperatives established with limited economic opportunities. The only reason for the long-term success of Denmark and Germany in this regard is their application of the "Feed-in Tariff", which is the most common incentive mechanism in clean energy. Again, in Canada's Ontario Province, the development of renewable energy cooperatives at this level was due to the Tariff Guaranteed Program, which started to be implemented in 2009 (Ticaret Bakanlığı, 2019).

It has been found that the number of community energy initiatives is increasing in the higher-income EU Member States. Community energy is most prevalent in the high-income countries of North-Western Europe and less so in Southern and Eastern Europe. This means that well-being can play a role in the purchasing power to afford investments. In addition to differences in economic status, there is reliance on centrally planned energy systems in Eastern European countries. In countries with a strong tradition of social enterprise and community, such as Denmark, Germany, or Belgium, the situation is reversed. However, there are also views stating that cultural differences in Eastern Europe are not due to distrust of social activity in general, but rather to national and local political institutions (Caramizaru, Uihlein 2020).

Many countries are developing government incentives and local projects to intensify the use of renewable energy, both due to its importance in reducing foreign dependency in energy and its environmental and economic benefits. Community systems, on the other hand, allow local renewable energy applications where the consumer is the producer, independent of government agencies and private companies. These types of energy projects range from renewable energy generation to energy saving and efficiency projects such as residential insulation.

Four main energy activities have been identified in Community energy: Generating energy, reducing energy use, energy management, buying energy (UK Community Energy Strategy, 2014). From this perspective, citizen energy ownership is not limited to electricity, and energy democracy is also making an entrance in the heat and transport sectors.

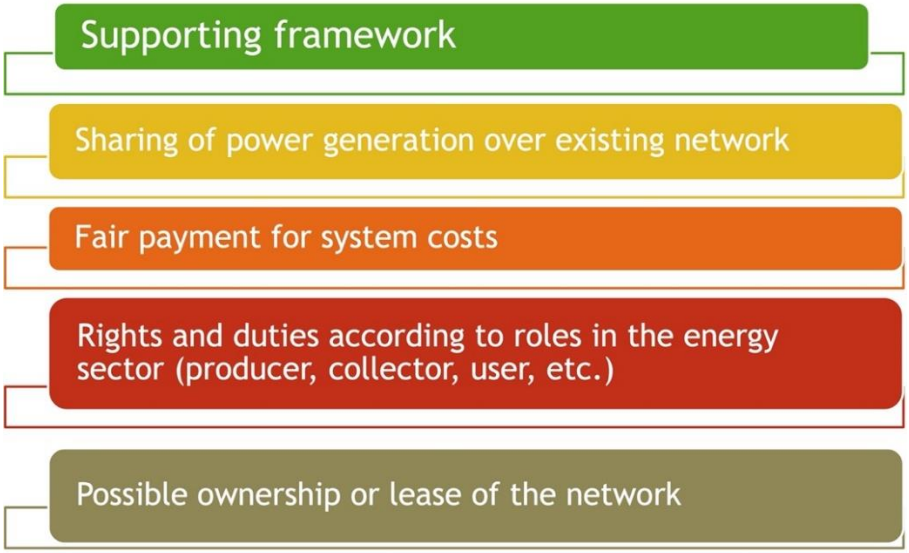

Figure 2.6. The guiding principles for citizens energy communities in the EU (Source: Community Energy Guide, 2020)

REScoop.eu is the European federation of renewable energy cooperatives established in 2011. As of April 2016, there are 1.240 individual REScoops and 20 member organizations representing 300,000 citizens in 11 European Member States. Routine management is carried out by the Belgian cooperative Ecopower. REScoop.eu states that community energy systems provide a fair circulation of gains of local and sustainable energy generation and rise local added value, especially in developing countries (Figure 2.6) (Rescoop,eu, 2020). REScoop.eu focusses on lobby work, collaboration between energy communities, exchange of best practices and learned lessons, participation in European projects to develop and test new technologies and initiatives to raise awareness. By reinforcing the renewable energy cooperative model in Europe and beyond, they work towards a green and sustainable energy landscape with citizens in the driving seat.

Interview with Int-3, we discussed the development process in Europe, the challenges at the current stage and their expectations for the future. Cooperation among citizens in the energy sector begins in the late 1800's and early 1900's. In rural regions, such as the Italian Alps, they have cooperatives that literally built the power grid, which they still run to this day. In Europe, the community energy has been ever-growing since the 1970s, and the European movement has really begun to expand in the last decade. Since the late 1990s, energy cooperatives in Denmark owned 70-80% of the installed

wind capacity, while in Germany at the end of 2017, around 42% of installed renewables capacity was owned by citizens.

In our interview with Int-4, it has been explained that Wildpoldsried residents in southern Germany are one of the best examples of community energy. Int-4 highlighted the financial, social and environmental opportunities that Wildpoldsried's energy cooperatives provide to the local people, local governments and generally to a country as follows:

> Stronger effects than many residents realize. In the meantime we achieve a yield of several million €/anno with our citizen plants, in addition 10% of the trade tax incomes of the Municipality. In the past, energy had to be purchased from surrounding towns. Large quantities of heating oil and electricity had to be bought from outside. Today, we sell our energy to the surrounding area and can thus support local associations and charitable projects. This means that the benefits go directly to the citizensLow membership fees of associations (sporting club, music club etc.) due to low membership fees and low additional costs. Many positive feedbacks promote the feeling of togetherness and make also proud all inhabitants of the Municipality

In one of our interviews, Int-3 explained that renewable energy cooperatives contribute to stimulating the local economy and creating employment while offering citizens the opportunity to participate in the energy sector. It is estimated that by 2050 almost half of all European households could be involved in renewable energy generation, of which around 37% could come through 'collective' participation in an energy cooperative. For Int-3, putting citizens at the heart of the energy transition will be essential for its success:

> We know that we have to shift our energy system to clean energies if we want to preserve our society as we know it. This transition will require considerable investment, which will be paid for by citizens: as consumers or as tax payers. To ensure fairness, citizens should enjoy equal opportunities to use the grid and have control over how their energy is produced, distributed and supplied. Energy cooperatives deliver a significant share of renewables investment and promote their local development and public support. They can further offer services to manage energy demand more flexibly, and integrate renewables safely and efficiently into the grid.

Various governments and organizations at the European Union level and in North America promote community energy practices as a strategy for the fulfillment of European Union related goals. (Romero, Rubio, D.az, 2015). Officials consider this an achievable goal, a floor rather than a ceiling (Bomberg, McEwen 2012).

Among the advanced economies, Canada, the United Kingdom, Germany and Denmark are already implementing Integrated Community Energy Systems (ICESs) concepts. It has been determined that especially these developed countries in Europe have witnessed a new wave of development with the establishment of energy cooperatives in their local energy systems (Koirala et al., 2016). For example, in the Netherlands, there are more than 500 initiatives for neutral energy, zero-emissions or low carbon communities. Similarly, there are more than 900 energy cooperatives in Germany (Koirala et al., 2016).

As noted earlier, Germany, Denmark and the United Kingdom take the lead in the creation and development of SECs in the EU. By contrast, Spain has few SECs, but it is one of the countries where the share of renewable energy sources in energy consumption; total, electricity, heating and cooling has experienced the largest increase in the last decade. In Spain, cooperatives have not been favored much by the Electricity Sector Act (54/1997). The cooperatives were not allowed to market electricity until recently. This may be why there are few cooperatives currently marketing electricity, similarly in Turkey. Also, marketing electricity is an activity that many SECs in the EU have begun to participate in with the aim of generating enough revenue to invest in generation plants. Investments in renewable electricity generation facilities, high financial risks, because it requires large sums of money to begin with, while the factory is not yet generating any income. Although incentives created in successive Special Regime arrangements reduce this risk, it is still difficult for a start-up cooperative to assume the risk, unlike already consolidated large companies that often invest in such projects (Romero, Rubio, Díaz, 2015). Therefore, energy communities can be completely owned by the community, or they can be developed by joint ownership or cooperation with the public or private sector (Yıldız et al., 2015).

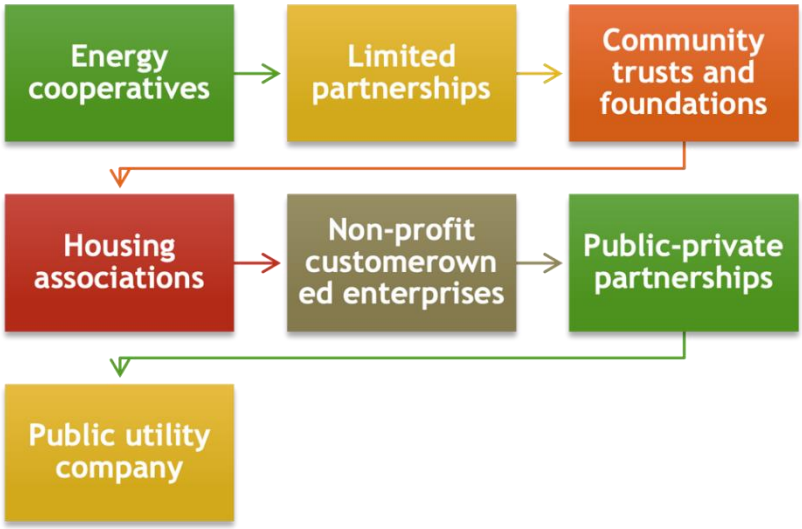

Figure 2.7. Possible legal structures for energy communities (JRC, 2020 Based On (Roberts, Bodman, And Rybski, 2014; Hanna, 2017; REN21, 2016)

As seen on the Figure 2.6, diversified citizens with governance models to participate in renewable energy projects. Depending on the legal form chosen, there are differences in management, decision-making, and obligation. (Yıldız et al., 2015). Also, community projects can take a variety of forms, from large cooperatives to off-grid systems. Although most community-based projects seem to be related to electricity generation, it is also known that their commitments have turned into more complex and closely linked private sector investment areas such as energy supply and energy efficiency (JRC, 2020).

The following part will examine several countries that are selected based on specific criteria in order to cover several most of the cases based on their governmental structure, legislative system, National enabling frameworks, Geographical scope, Activities, Participants, Autonomy, Effective control. Renewable energy communities differ in these subjects and for this reason, countries such as Denmark, Germany, UK, where more common and successful examples are located in Europe, as well as Poland where applications have only recently increased, and Canada as a different continent will be examined.

2.4. Energy Communities in the World

On this chapter, the similar and different aspects of community energy practices in the countries identified above will be examined. The public administration systems and local governments of each country may have different or similar aspects; It is foreseen that there is no common legislation, economic opportunities, or motivation in the transition to local energy systems and that there are regional differences in practices, it is foreseen to form opinions and suggestions for community energy and to diversify the practices in Turkey.

2.4.1. The UK

In the UK, the Community Energy Strategy supports a community approach to energy strategy. (Tweed, 2014). Various civil society groups and social enterprises, schools are involved in these systems together with local government or utilities (Seyfang, Park, Smith, etc. 2013).

For CE practices at The UK and it is clear that the need to develop renewable energy for climate change and energy security. Domestic consumers are also demanding a better and more transparent service from their suppliers. These demands can be met by reducing energy policy from the national to the local level. There will be many and varied limitations on the potential of this approach. These limitations depend on factors such as the availability and viability of community energy projects and the capacity to partner with Local Government within a community.The degree of government commitment to growing the community energy sector is essential. Its urban counterpart has recently joined the Rural Community Energy Fund and offers financial and organizational support to developing community projects (Tweed, 2014).

The experience of large organizations with demand-side measures with public sector partnerships has been influenced by the Energy Company Obligation and Green Deal programmes. These partnerships have produced mixed results and may leave the "Big 6" out of local energy partnerships until government policies become more consistent. There is still much to be gained from generating and supplying local clean energy for the Community energy sector, subsidiaries and Local Governments. In addition, communities that want to install solar panels on their roofs or implement energy

efficiency programs together will have a higher bargaining power. According to a recent survey in the UK, 42% of respondents show interest in community energy participation if it results in energy bill savings. Still, citizens' incentive to participate in ICESs is low because benefits do not only accrue to those who invest, but rather attract free-riding behavior among citizens (Koirala et al., 2016). In areas where community energy plans have been developed, official local authority support, guidance and policy have been important factors in promoting the consideration and development of low-carbon and renewable energy plans that are managed by the local community or benefit the local community (Wilson, 2017).

The UK's research results for CE show that there is a large number of civil society activities in the sustainable energy field tackling a wide range of sustainable energy and related issues and growing as a sector. With appropriate policy support and clear funding flows and robust intermediaries to share learning, community energy is anticipated to continue to grow (Seyfang, Park, Smith, 2013). Also, in the UK, the Scottish government actively supports community and local property, and its targets 1 GW of renewable electricity capacity local by 2030 and new projects from 2020 have a local ownership element. (JRC, 2020).

2.4.2. Germany

More than half of Germany's remarkable renewable energy portfolio belongs to citizens and farmers. There are more than 900 energy cooperatives operating in Germany (Koirala et al., 2016). According to the German Cooperative and Raiffeisen Confederation (DGRV) survey, there are currently some 870 citizens' energy cooperatives in Germany, with over 180,000 members and they have invested 2.7 billion euros in renewable energy. Most cooperatives operate solar power installations. However, DGRV mentions that increasing regulation threatens the energy cooperatives of German citizens because reduced support payments and the move to license auctions for new capacity make it difficult for them to contribute to the expansion of renewable energy sources. It is only 54 percent of cooperatives willing to invest in these relatively small facilities, compared to 71 percent in 2018, for example, after support for roof-mounted solar systems has waned (Cleanenergywire, 2021).

The German transition process, called the "Energiewende" (Energy Transition), has been characterized by various actors building renewable power plants. This distinctive feature of the German renewable energy sector has been enhanced by the introduction of the fixed feed-in tariff. Maintaining this diversity of actors has become a political goal. Since 2011, guaranteed tariffs have been kept lower than retail electricity prices to encourage self-consumption in Germany. Currently, the feed-in tariff for such systems is comparable to wholesale electricity prices. With technology learning, the cost of storage systems is expected to decrease. Photovoltaic storage systems are also expected to reach grid parity in the near future, which will further strengthen the off-grid situation (Koirala et al., 2016). Discussions about this goal had started with the reductions of feed-in tariffs for photovoltaics (PV) in 2012 and the introduction of a mandatory market-premium system in 2014. It has been intensified since because of the proposed change from feed-in tariffs to a tender-based system (Holstenkamp-Kahla, 2016).

Citizens in developed countries are willing to invest in local energy systems through alternatives. For example, many communities in Germany are self-organized as energy cooperatives. Members in these cooperatives receive an average of 4% dividends, which is much higher than the interest rate offered by banks (Koirala et al., 2016). In addition, communities that want to install solar panels on their roofs or implement energy efficiency programs together will have a higher bargaining power.

Regression analyzes show that social norms, trust, environmental concern, and community identity are important determinants of willingness to participate in community energy. However, using mediation analyses, we found that the influence of community identity is mediated through changes in social norms and trust. Both having a renewable energy system and living in the countryside rather than the urban community increase the likelihood of participation (Kalkbrenner-Roosen 2016).

Germany is adopting a variety of renewable sources and participation models. Half of the renewable energy production facilities are owned by private households, 40% by cooperatives and 10% by farmers. Solar-powered cooperatives and wind parks have proven the most successful and leading. While sustainability is of increasing interest

and urgency in cities, such initiatives can be found in both rural and urban areas. (Hoppe et al., 2015).

2.4.3. Canada

Canada has developed a roadmap to benefit most of its communities from integrated community energy solutions by the year 2050.

A rising trend in Canada is the creation of community energy plans, where decisions formerly left to regional energy agencies or private individuals are now considered at the community level. The desire to reduce greenhouse gas emissions and become more energy self-sufficient is driving this change. Theoretically, management at the local level is desirable because it achieves these goals through improvements in three areas: energy efficiency, energy conservation and the transition to renewable energy sources (Parker, 2009).

In Canada, renewable energies are not very prominent in the recommendation section of the community energy plans. They are not viewed as a priority means to improve the local energy system, when compared to the efforts made in the CEPs to engage people in increasing energy efficiency and conservation. Their lower ranking on the planning agenda could be caused by several factors: the need for more information regarding renewable options, a lack of local capacity or funding, or the relatively low price of conventional electricity and fuel in Canada (Parker, 2009).

'Local action plans for climate change' (LAPs) in Canada have developed from the Federation of Canadian Municipalities (FCM) and Local Governments for Sustainability network of Partners for Climate Protection (PCP) program where their member communities are being urged to act on climate change at the local level, incorporating into their local action plans details for local energy plans (Parker, 2009). In Canada, renewable energy recommendations for action and further research are seen most prevalent in the municipal sector. It point to clear evidence that communities are choosing to meet their energy planning goals more often through improvements in energy efficiency and savings than incorporating renewable energies into their energy mix.

2.4.4. Denmark

Denmark has strong traditions of community ownership and social enterprises have the highest number of citizen-led energy organisations. Non-profit customer- owned enterprises are legal structures used by communities that deal with the management of independent grid networks. Ideal for community district heating networks common in countries like Denmark. Housing associations can be found in Denmark and the members or the tenants of the social housing estate are responsible for managing the estate. Also, non-profit customer-owned enterprises are legal forms for community ownership that can be found in Denmark. In general, wind energy dominates in other areas with good wind conditions such as Denmark and mostly focus on district heating and biomass, too.

Denmark is divided into five regions and 98 municipalities with popularly elected councils administered at both levels. While the national government is responsible for most energy issues, city councils are responsible for a range of local and environmental issues, and many deal with climate change. There is a long history of community ownership of energy supply in Denmark, with communities coming together to invest in wind turbines since the late 1970s. Therefore, a greater proportion of renewable energy generation belongs to communities than to other countries. In 2013, renewable energy accounted for approximately 22% of actual energy consumption and 25% of electricity consumption, and 70-80% of wind turbines in the country were thought to be under community ownership. Also, in 2012, the government passed a broad majority agreement in Parliament on a set of measures that would ensure that all energy supplies are met by renewable energy by 2050. In terms of heating, 60% of the residences and 45% of the total. The heat requirement is met by district heating. The energy market in Denmark also operated relatively outside of free market principles, treating both electricity and heating as common goods before liberalizing the electricity market in 1999 (Caramizaru, Uihlein 2020). On the other hand, the electricity sector in Denmark was established 100 years ago as cooperatives and municipal companies. Central heating was established mainly as cooperatives and municipal companies since 1950, centralization and larger power plants until 1990. Beginning in the 1980s, new decentralization cooperatives with cooperative-owned, grid-connected wind power and gas cogeneration of heat and power (CHP) primarily

through district heating. leads to closure. This includes the open electricity market, the suspension of the tariff guarantee in Denmark.

Today, Denmark still implements the electricity market directive with public participation and the electricity law are be discussed in Parliament for the renewable energy directive that would implemented in future.

2.4.5. Poland

In Poland, the Renewable Energy Resources Law defined the term 'energy clusters' as civil law agreements with various parties, including natural persons, legal entities, scientific bodies, research institutes and local government units. The agreement deals with the generation, distribution or trade of energy from renewable sources or other sources and balancing demand within a distribution network whose voltage is below 110 kV (Wiktor-Sułkowska, 2018).

The cluster functions as a civil law contract, meaning it has no legal personality and is not conducted as a business activity. Nevertheless, the cluster shows an interest in local values, the sustainability of the area and the involvement of local residents and municipalities. It can take the form of a local energy community or micronetwork balancing supply and demand at the local level, with both private and public actors (Caramizaru, Uihlein 2020).

Poland's first and so far only energy cooperative was established in June 2014 as an initiative of a private energy company BioPower in cooperation with another ESCO and four local municipalities in the eastern region of Lubelskie voivodeship. Spółdzielnia Nasza Energia (Eng. Our Energy Cooperative) plans to install up to 15 small energy and heat generating biogas plants (0.5-1 MW each) in all member gminas (Polish local municipalities) based on an innovative project proposing a local project . system of "energy nodes" interconnected by an autonomous grid. This joint project by Bio Power Sp., Elektromontaz Lublin and four municipalities: Sitno, Skierbieszow, Komarow-Osada, Labunie. The cooperative is a private-local government initiative created in response to high electricity prices by system enterprises. The task is to supply electricity and, if possible, heat energy of public buildings as well as households. An ongoing challenge is the legal chaos and instability of the legal system,

with new, revolutionary changes to the law proposed by the government. In Poland, the success of the Nasza Energia cooperative can largely depend on the regulation and public support system that currently favors large state-owned energy companies over small renewable energy companies (Communitypower.eu, 2021).

2.5. Concluding Remarks

The guiding principles for citizens energy communities in the EU are supporting framework, sharing of power generation over existing network, fair payment for system costs, rights and duties according to roles in the energy sector, and possible ownership or lease of the network. Also, "energy communities" and sets legal frameworks for certain categories of community energy and the following common conceptual elements: Governance, ownership and control and purpose to create social and environmental gains rather than financial profits.

All of these are kinds of renewable energy policies and applications that aim to expand electricity production from clean sources, thereby reducing emissions. The purpose of this communities in substance to increase energy security in local level and to guarantee the electricity supply system at a reasonable price. When community energy is considered as a part of urban policies for a local government system, it has been determined that objectives such as reducing energy costs, generating income through the sale of excess production to the grid or meeting climate targets are on the agenda. It has been observed that the practices in different countries are supported by support mechanisms, national enabling frameworks, the increase in the number of participants and local energy activism.

Within the scope of the study, the transition to local energy systems, it is accepted that there is no common legislation, economic opportunities or motivation to advance demand-oriented localization and that the practices include regional differences, and activities for community energy are compared. However, the various governance models enable citizens to participate in renewable energy projects. Depending on the type of organization, governance structure, decision-making and obligations differ. Based on their governmental structure, legislative system, National enabling frameworks, Geographical scope, Activities, Participants, Autonomy, Effective

control, energy communities can be very heterogeneous in organizational models and legal forms.

The following section examining Turkey's energy targets will be devoted to community energy practices based on local energy management and green economy policies. After the process of energy cooperatives, as one of the most important examples of community energy in Turkey will be examined. Interviews in next section are consisted the comments of representatives and administratives' opinions from Turkey. In addition, the applications in Turkey will be compared with the examples in the world in the next section.

CHAPTER 3

RENEWABLE ENERGY RELATED LOCAL ACTIVITIES IN TURKEY

In this chapter, “Turkish Renewable Energy Sector” discusses Turkey’s history of the electricity market and current situation within the energy mix and renewable energy. When the functioning of the energy system in Turkey is examined, it has been determined that renewable energy has great potential. Although many tools and initiatives have been developed for the development of the clean energy sector and technologies, after the signing of the Paris climate agreement, how the necessary commitments can be fulfilled and the deficiencies will be examined in the upcoming period. In addition, the interviews in this section consist of the comments of representatives from Turkey.

3.1. Introduction

Turkey has a favorable geographical position in terms of the diversity and potential of renewable energy sources. We will discuss the development process of renewable energy in Turkey by first examining the development of the electricity sector. The report called Turkey Electricity Market Overview is emphasized the development of Turkey's electricity market can be examined under three periods. Important steps have been taken in terms of the growth and liberalization of the market with the enactment of the Electricity Market Law, which is accepted as the beginning of the growth period (Çolakoğlu, 2020).

The Beginning Period (1920s-1960s) is a period in which various actions were implemented by public and private organizations in order to expand and increase the use of electricity throughout the country. Despite many achievements, throughout the period; long-term / wide-ranging planning deficiencies and the need for regulatory / supervisory institutions came to the force. The history of electrical energy, which is considered one of the most important sectors of the 21st century, goes back two centuries. It is known that electrical energy was first used in daily life in 1878 and the

first power plant was put into service in London in 1882. In our country, the first electricity generation was realized with a small 2 kW water turbine installed in Tarsus in 1902. The first large power plant was the thermal power plant with a power of 15 MW, which was established in Istanbul Silahtarağa in 1913. In 1935, Etibank, Mineral Research and Exploration (MTA), Electrical Works Survey Administration (EIEI) were established, and then the General Directorates of Iller Bank and State Hydraulic Works (DSI) came into operation. In the 1950s, parallel to the economic developments in the world, power plants started to be built and operated by the state and private sector. The energy, which is shaped by local needs, the central government has a regulatory function, and the supply is provided by the enterprises of municipalities and unions, has entered a process of moving away from the nature of public goods in this process, and energy, whose use value is increasing day by day, has begun to be evaluated by the players of the market economy.

The Restructuring Period (1960s-2000s) is a period in which serial installed capacity increases are observed and studies for long-term planning and liberalization of the market begin. Turkey Electricity Authority (TEK) and the Ministry of Energy and Natural Resources (MENR) has emerged as institutions for the first time during this period. In this period, the share of free electricity producers in electricity generation increased with the Build Operate Transfer and Build-Own-Operate projects.

In 1982, the electricity facilities in the hands of the Municipalities and Unions were transferred to the Turkish Electricity Authority TEK by Law No. 2705, from now on, all sales, including the village sales, were made by TEK. The new public management, in which the public administration is restructured according to the management principles of the private sector and turned into a field of joint action with the private sector representatives, and the structure in which the financial burden is transferred to the local (Bayırbağ, 2017). can also be evaluated in terms of the energy sector after this period. While transferring the financial burdens to the local with the autonomy provided by decentralization and reaching opportunities to expand the application areas of locally focused and fair energy systems such as community energy, the public, and private sectors as well as non-governmental organizations that function as the lobby, focus on corporatization and profit maximization rather than community practices. develops application areas.

According to advocates of the privatization, electricity generation and transmission development plans are made in order to meet the electricity demand of Turkey in a continuous, reliable, high quality and economical. As an example, the law on the privatization of the natural gas distribution section of the Ankara Electricity and Gas Institution (EGO) General Directorate within the scope of Ankara Metropolitan Municipality, to pay its debts to the Treasury and BOTAŞ and to provide resources for the construction of the subway, entered into force in 2007. Responding to the problem of social justice while maintaining a policy of limited intervention in the free market and not being an extra burden on the state budget while doing this is valid in this structure (Bayırbağ, 2017).

The Growth Period (2000s-Present) is the period that begins with the entry into force of the Electricity Market Law. During this period, Energy Market Regulatory Authority (EMRA) was established as an independent market regulator and public institutions in the market; New institutions were created by separating their areas of expertise according to their duties and responsibilities. Many privatizations took place in the later stages of the growth period. In this way, the electricity produced by free producers has exceeded the public production.

The reform of the electricity market in Turkey, to develop a competitive market and in order to achieve sustainable growth in this market in March 2001, it started with the enactment of the Electricity Market Law No. 4628. The Electricity Market Law aims to provide low-cost and environmentally friendly electricity to consumers. EMRA, operating as an independent institution responsible for the regulation of the electricity market, was established under the law. In the following years, EMRA's functions were expanded to include natural gas, liquefied petroleum gas and oil markets. EMRA takes its functions into effect in line with the decisions of the Energy Market Regulatory Board. Another important development in 2001, Turkey's Electricity Generation and Transmission Company (TEAS), is divided into three different companies. In this period, following the liberalization of the market and the structural reforms of regulatory and supervisory institutions, privatization activities of state-owned electricity distribution and generation companies began. As developments in Turkey between the years 2001-2020 Electricity Sector: (PwC & Aplus, 2020).

- Electricity Market Law
- Establishment of EMRA
- Organized Electricity Market Establishment
- Changing the Renewable Energy Law
- New Electricity Market Law
- Completing the Privatization Process of Distribution Regions
- Announcement of (Renewable Energy Resources Zones (YEKA) Auctions
- Electricity Purchase Guarantee for Lignite Plants
- Completion of First WPP and Solar Power Plant YEKA Tenders
- The merger of EÜAŞ and TETAŞ under the roof of EÜAŞ
- Ancillary Services Market
- Implementation of the Capacity Mechanism
- The entry into force of the new Unlicensed Electricity Generation Law
- Completion of the second YEKA Wind Power Plant tender
- Significant completion of BOO and BOT contracts (Build-Operate-Transfer (BOT), Build-Operate (BOO))
- Publication of Mini YEKA Solar Power Plant-3 competition announcement

With the developments outlined above, electricity generation can be carried out by independent electricity generation companies and public institutions with generation licenses in Turkey and installed capacity as of the end of 2020 has reached 95.890,6 MW. To evaluate the share of renewable energy in this installed power, the roadmap of the sector will be examined in the next section.

3.2. Development of Renewable Energy in Turkey

Reducing dependency on imported energy sources and closing the current foreign trade deficit are among the main policies of Turkey in the energy sector. For this purpose, efforts have been initiated to encourage renewable energy investments in Turkey, and as a part of these efforts, Law No. 5346 on the Use of Renewable Energy Resources in Electricity Generation entered into force on May 10, 2005.

Turkey Electricity Market Law (No. 6446) is the legal basis needed for industry players to unlicensed production of electricity. Unlicensed generation has been one of the main factors contributing to the increase in installed power capacity in recent years.

The primary purpose of unlicensed production is to provide the necessary facilities for industry and residents to have the production capacity to meet their own consumption. This mechanism was mainly created to encourage domestic consumption for both households and industrial establishments.

- Unlicensed power plants differ from licensed power plants in the following basic aspects:
- No obligation to establish a company in unlicensed production,
- The application process is much easier to understand and requires less time compared to the licensed production alternative.
- Obligation to enter tender processes absence,
- Making applications for the installation of the power plant throughout the year,
- YEKDEM is not obliged to renew annually,
- No need for meter measurement data, monthly notification system in production,
- EMRA approval in share transfers not require.

As seen on Table3.1 below, The Turkish Electricity Market Law (No. 6446) has created the necessary legal basis for unlicensed electricity generation for the sector players. The vast majority of unlicensed installed power capacity increases consist of solar power plants.

Table 3.1. Basic legal arrangements made in Turkey in the field of renewable energy between 2000-2020

The Law on the Use of Renewable Energy Sources for Electric Energy Generation dated 2005 (Number 5346) (YEK Law) This law is a part of the main legislation covering the procedures and principles regarding the protection of renewable energy sources and the certification and use of the energy produced from these sources. The stated purpose of the law is to expand the use of renewable energy sources to produce electrical energy, to benefit from these sources in a safe, economical, and qualified way, to increase the diversity of energy sources, to reduce greenhouse gas emissions, to evaluate waste products, to protect the environment and to develop the relevant manufacturing industries to achieve these goals.
Significant changes were made in Law No. 5346 in 2011. YEKDEM's first introduced model did not offer attractive opportunities for investors and received limited attention. For this reason, the new mechanism created; has offered additional contributions and new purchase guarantees that differ according to the type of energy for freelance electricity producers who use locally produced machines and equipment in their power plant investments. After the change came into effect, YEKDEM's purchase tariff attracted great interest from freelance electricity producers, especially since it offered attractive prices against MCP (market clearing price), which decreased in the day-ahead markets after 2014. Within the scope of YEKDEM, which was reorganized in 2011, the YEKDEM purchase guarantee was valid for the first 10 years of the activities of renewable energy power plants that were put into operation before 31 December 2015.
With the EMRA decision published in the Official Gazette dated November 18, 2013, it was determined that renewable energy power plants that were put into operation between January 1, 2015, and October 31, 2020, can also benefit from the YEKDEM purchase guarantee for 10 years.
Electricity Market Law No. 6446 dated 2013 This law covers all parts of the electricity market, including electricity generation, transmission, distribution, wholesale and retail sale, import and export, market operation, and the rights and obligations of all real and legal persons engaged in such activities. The Turkish Electricity Market Law (No. 6446) has created the necessary legal basis for unlicensed electricity generation for the sector players.
The regulation on the New YEKA investment model entered into force on October 9, 2016, after it was published in the Official Gazette. Within the scope of this investment model, installed power capacities in predetermined renewable energy resource areas are allocated to potential investors, taking into account their proposals. In these tenders, there is also an obligation to construct power plants with predetermined technical specifications and domestic components. The electricity produced in the power plants developed with the YEKA model is evaluated within the scope of YEKDEM. The electricity purchase prices to be valid for these power plants are determined by the auction method in the competition within the tender.
According to the Presidential Decision published in the Official Gazette dated May 10, 2019, the limit for unlicensed electricity generation was increased from 1 MW to 5 MW.
Unlicensed generation plants that came into operation after May 12, 2019, will benefit from a 10-year purchase guarantee over the retail one-time active energy price of the consumption facility's subscriber group. In addition, the regulation on unlicensed production was amended on 12 May 2019. With the amendment, the monthly set-off system was introduced. With monthly set-off, it is stated that electricity producers will be paid every month over the difference between consumption and production.
With an amendment made in the Electricity Market Law at the end of 2020 with the Unlicensed Generation Regulation of May 9, 2021, it was allowed to establish an unlicensed generation facility based on renewable energy sources, without being subject to any additionally installed power limit, provided that it is limited to the contractual power in the connection agreement.

Legal regulations in solar energy in Turkey have been one of the rising areas in terms of capacity increase and one of the most frequently regulated areas in terms of legislation, especially thanks to a large number of small-scale unlicensed projects. In the development process of the electricity sector in Turkey, incentive mechanisms for both partial fossil fuels and renewable energy sources have been developed and put into use within the scope of ensuring electricity supply security and increasing the electricity produced from renewable energy sources. Among these mechanisms are the capacity mechanism and YEKDEM (Renewable Energy Resources Support Mechanism) and YEKA (Renewable Energy Resource Area) for renewable energy resources.

For instance, the electricity from Solar Energy Production in Turkey continues with three different models:

Unlicensed Electricity Generation

- Land Applications
- Roof and Facade Projects under 10 kW
- Roof Projects over 10 kW (internal consumption)

a. Licensed Electricity Generation (Utility Scale)

b. YEKA Projects (Renewable Energy Resource Area)

In the **Annex-2**, there are different installed power generation, YEKDEM supports and income items for 3 different types of renewable energy currently in production. While hydroelectric and biomass power plants are large-scale projects developed depending on the source and with high cost, it is seen that solar power plants can be established in any suitable place with the desired capacity and size, with land and roof types, and income can be generated.

Table 3.2. Breakdown of installed capacity by energy resources in 2019 and 2020 (TEİAŞ, 2021)

Power Resources	**Installed capacity (MW) 2019**	**Installed capacity (MW) 2020**	**Added capacity (MW) (2019-2020)**	**Increase (2019-2020) %**
Fossil fuels based thermal power plants	47.662	47.793	131,7	0,2
Hydroelectric	28.503	30.983,9	2.480,9	8,7
Wind	7.591,20	8.832,4	1.241,2	16,3
Solar PV	5.995,20	6.667,4	672,2	11,2
Geothermal	1.514,70	1.613,2	98,5	6,5
Total	**91.267,00**	**95.890,6**	**4.623,6**	**5,06**

As seen on Table 3.2, the share of renewable energy in the total electric consumption of Turkey in the end of 2020 was approximately 51,32% and a total of 6.6 GW PV and about 8.8 GW onshore wind power capacity accounts for about 16% of the country's total installed capacity. Since all of the natural gas and almost all of the coal is imported, it is stated that Turkey should increase its self-sufficiency by addressing its rich renewable energy resources potential. In the next section, the main sources in Turkey's renewable energy outlook will be examined.

3.2.1. Drivers for Renewable Growth

The figure below shows the share of the total renewable installed power consisting of hydraulic, geothermal, wind, solar and biomass in the total installed power between 2000-2020. Over the years, the share of renewables in total power has been increasing and it can be seen in Figure 3.1 below.

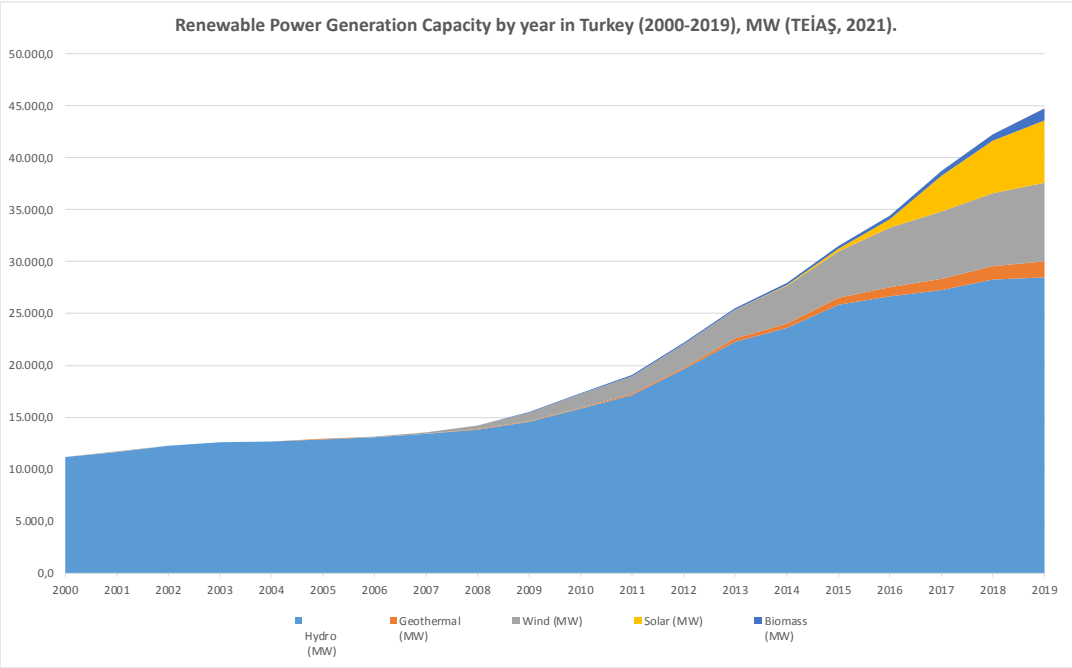

Figure 3.1. Renewable power generation capacity by year in Turkey (2000-2019), MW (TEİAŞ, 2021)

Hydro

The country's hydraulic resources are used more widely and efficiently than other types of renewable energy. The installed capacity of renewable energy resources has increased rapidly since 2008, especially with hydroelectric power plant investments. 48% of the increase in the renewable energy installed capacity of the country between 2009 and 2020 is due to hydroelectric investments.

After 2014, the increase in installed power in the field of renewable energy has mostly come from non-hydraulic renewable energy plants. The reasons for this situation; it is understood that the purchasing tariffs offered within the scope of YEKDEM are above the PTF and that the investment-related costs have decreased with technological developments. At the end of 2020, the installed capacity of hydro power is 30.983,9 MW and constitutes 63 percent of renewable energy capacity in Turkey (Figure 8).

Wind

The country has a high untapped wind energy potential. The 2023 target foresees the commissioning of a certain part of the unused capacity. In renewable energies, especially wind power plants, it is observed that the increase in the installed power

capacity of the power plants has a positive effect on generation efficiency. The increase in tower heights and rotor diameters causes the production to grow exponentially under the same weather conditions. For this reason, there are economic advantages to investing in larger wind turbines. (The average wind turbine has an installed power of 3 MW.) The installed power limits of unlicensed generation are a deterrent for unlicensed wind energy investors. There are deterrent factors in the unlicensed installed power capacity of renewable energies (especially wind) due to economies of scale. At the end of 2020, the installed capacity of wind power is 8.832,4 MW and constitutes 18 percent of renewable energy capacity in Turkey (Figure 8).

Solar

Solar energy has been one of the fastest growing fields, especially with the large number of small-scale unlicensed projects. YEKDEM and the Feed-In-Tariff triggered a major transformation in Turkey and worldwide respectively. Many clean energy plants and the prices dropped with this mechanism. Installed power goals; due to the decrease in SPP investment costs, increased efficiency and the fact that the purchase tariff offered under YEKDEM was above the market price, it was significantly exceeded in 2019. Most of the unlicensed installed power capacity increases consist of solar power plants. After the new regulation on unlicensed production in 2019, investments in these areas are expected to be only for domestic consumption in the future. Today, solar energy represents a smaller portion of YEKDEM due to the total installed capacity and capacity factor; hidro and wind plants are affected the most. In addition, there is no solar energy investment representing YEKDEM other than hybrid power plants. At the end of 2020, the installed capacity of solar power is 6.667,4 MW and constitutes 14 percent of renewable energy capacity in Turkey (Figure 8).

Geothermal

The most up-to-date installed power targets are shared in the Strategic Plan covering the 2019-2023 period. In this document, Geothermal and Biomass targets have been consolidated for the 2019-2023 period. The geothermal resources in the country are low-medium enthalpy regions widely used for tourism, heating or industrial use, and 10% of the resources can be used for electricity. Geothermal energy potential in Turkey may become one of the highest capacity with the existing world countries. At

the end of 2020, the installed capacity of geothermal power is 1.613,2 MW and constitutes 3 percent of renewable energy capacity in Turkey (Figure 8).

Biomass

Biomass technology has been less preferred in terms of investments compared to renewable energy sources powered by solar and wind. At the end of 2020, the installed capacity of biomass power is 1.115,6 MW and constitutes 2 percent of renewable energy capacity in Turkey (Figure 8).

As can be seen from the data given above, most of the unlicensed installed power capacity increases consist of solar power plants. After the new regulations on unlicensed production, investments in these areas are expected to be only for domestic consumption in the future. plants. The share of other renewable energy sources in the unlicensed installed power capacity remained limited. There are some major reasons for the large share of unlicensed solar energy (Çolakoğlu, 2020):

The first reason is that there are deterrent factors arising from economies of scale in the unlicensed installed power capacity of other renewable energies (especially wind). This situation can be explained in two different ways:

1) In renewable energies, especially wind power plants, it is observed that the increase in the installed power capacity of the power plants has a positive effect on production efficiency. The increase in tower heights and rotor diameters causes the production to grow exponentially under the same weather conditions. For this reason, there are economic advantages to investing in larger wind turbines. The installed power limits of unlicensed generation are a deterrent for unlicensed wind energy investors.
2) Construction cost per kW decreases as the size of the power plant increases in power plant investments. However, it is observed that the cost per kW in solar power plants varies in a limited way with the size of the plant. This makes it possible to make decisions independent of scale when deciding on solar power plant investments. In addition, the fact that solar energy is cheaper compared to other technologies increases the rate of solar technology in small power plant

investments. The costs of solar power plants have dropped significantly in the last few years.

The second reason is that the country has a serious solar energy potential. 2,741 hours of annual sunshine duration in Turkey (7.5 hours per day) and annual total incoming solar energy 1,527 kWh / m2 was observed. In addition, availability of suitable dry land in areas exposed to more sunlight provides low-cost making opportunities.

The third reason is that the number of variables to be considered in unlicensed solar power plants is more limited. For example, there are contractual obligations with municipalities for the collection of biomass waste, or an active geothermal resource is needed for geothermal energy production. The availability of abundant resources and limited variables makes it possible for investments to be realized in a low competitive environment.

At the end of 2020, cumulative installed PV power in Turkey has reached about 6.513,0 MW and increased with a 9% growth compared to the previous year's data, 5.995,20 MW.(Table 3.2) The photovoltaic installations started to take off in 2014 with 40 MW installed capacity. In 2020, newly added PV power systems a total of 519 MW solar power plant in the first 11 months of the year was added to the installed capacity of Turkey. A total of 463 power plants (licensed and unlicensed) were commissioned within one year **(**Figure 3.2).

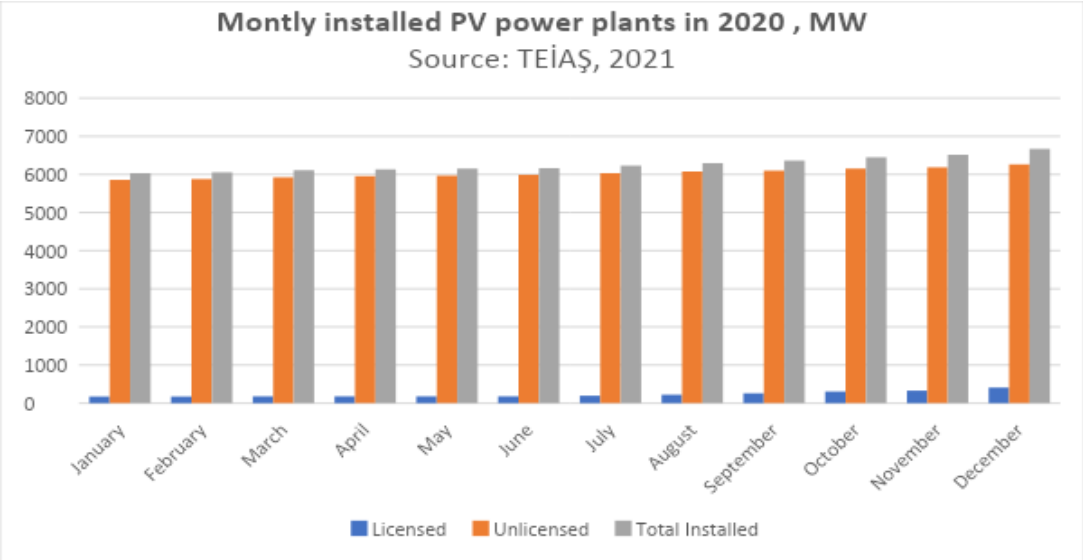

Figure 3.2. Montly installed PV power plants in 2020 (TEİAŞ, 2021)

Another important issue for the development of clean energy is the establishment of hybrid plants in Turkey. A new directive paves the way for hybrid power plants to generate electricity using multiple sources in existing and future licensed power plants. The directive will allow the installation of SPPs in coal, natural gas, and geothermal power plant fields. EMRA has prepared a new methodology for power plant sites. This methodology, which has just been included in the implementation process, is planned to contribute to new investment opportunities and employment.

The stated purpose of previous parts are to show the use of renewable energy sources to generate electrical energy, to benefit from these sources in a safe, economical and qualified manner, to increase the diversity of energy sources, to reduce greenhouse gas emissions, to evaluate waste products, to protect the environment and to develop relevant manufacturing industries to achieve these goals. Achieving all these or major part of these goals within a certain timeframe presents fundamental challenges for societies such as Turkey, which already has a high dependence on fossil fuels and imported energy. The next section will assess these key challenges to Turkey's energy transition.

3.2.2. Challenges for Renewable Growth

Renewable energy projects stand out as technology-intensive investments that can be developed primarily with government supports and incentives. It seems necessary to implement the appropriate legislation and technologies quickly in this process. However, there are situations where frequently changing legislation and economic inadequacies can hinder the progress of this transition process in Turkey.

The researches shows that the solar energy in Turkey with an expected potential of minimum 500 GW. Also, the global investment in renewable energy capacity reached $2.6 trillion at the end of 2019 (Andersen, et al., 2019). In particular, the main obstacles to the development of renewable energy can be found in the restrictions placed on local production by prioritizing large investments in renewable energy, the lack of capacity to feed the excess production at an affordable price, and the difficulties in accessing finance.

However, the Ministry of Energy and Natural Resources has published the Strategic Plan covering the years 2019-2023. The primary goal in the plan is to increase the ratio of the installed power of the electricity based on domestic and renewable energy sources from 59% to 65% of the total installed power. While the technological transformation applications are being carried out in the electricity sector, efforts to increase energy efficiency will also continue. In 2023, a total of 56,804 MW based on renewable energy sources is targeted, including 10,000 MW in solar energy, 11,883 MW in wind energy, 32,037 MW in hydroelectric energy and a total of 2,884 MW in geothermal and biomass (Enerji ve Tabii Kaynaklar Bakanlığı, 2020).

In Turkey, the biggest responsible for the external deficit is shown as energy imports. Another element of the external deficit arising from electricity generation is the use of imported coal, which has increased rapidly in recent years. Imported coal power plants, in addition to increasing the foreign trade deficit, also cause irreversible damage to the social and natural environment. These investments, with the effect of regional agglomeration, cause the reaction of the local people and all citizens who are sensitive to the environment. A study published by EMBER, an independent think-tank that prepares climate and energy studies, reveals that there was a record decrease in coal generation in 2020. Although China is in the leading position in renewable energy, it is clearly seen that China resisted this downward trend in coal generation during the epidemic and stood out as the only G20 country to show a massive increase in both electricity demand and coal power in 2020. It is indicated that 12 percent of the electricity production in Turkey is provided by wind and solar energy, and clean energy production has shown a progress rate just above the world average of 9.4 percent (Brown, 2021).

On the other hand, recent developments require Turkey, which meets 30 percent of its electricity capacity from coal, to provide this production from renewable and carbonless sources. As stated in the previous section, Turkey belatedly ratified the Paris Agreement and re-engaged in the global climate crisis response. It has been five years since Turkey, which signed the agreement in 2016 and became a party in 2021, made the declaration while signing it. While this statement should have been updated under normal conditions, some time was gained by being a late party to the agreement and the climate summit was postponed due to the epidemic. Turkey's Chief Climate

Negotiator Mehmet Emin Birpınar also said that it will take one year to prepare the new statement (BBC, 2021).

In 2016, Turkey set a very weak target and predicted that its emissions would increase rapidly, and stated that they could only reduce this increase, and made a statement that included "reduction from increase". The mathematical equivalent of this is to keep greenhouse gas emissions, which exceeded 450 million tons in 2015, below 929 million tons in 2030. Although it is known that developing countries are approached more tolerantly, Turkey promised not to make a significant contribution by committing to increase its greenhouse gas emissions more than twice. Considering that the emissions in 2019 remained at 506 million tons (TUİK, 2020), it can be said that the rate of increase was not at all as planned and that Turkey was able to achieve better than the target given even "without taking any special climate measures". The fact that renewable energy sources, with their falling costs, have become more attractive compared to coal and natural gas has played and will play an major role in slowing the increase in emissions.

On the other hand, before this agreement, it was announced that Turkey would show some support to the international effort. The Minister of Environment and Urbanization, announced the "Climate Change Action Plan" of 14 items covering six provinces in the Black Sea Region of Turkey. The items of the proceedings of the Workshop on Fighting Climate Change are as follows (Çevre ve Şehircilik Bakanlığı, 2021):

1) A comprehensive Report on Fighting Climate Change containing the fundamental responsibilities and actions for fighting climate change will be submitted to the Parliament for approval.
2) The National Climate Change Strategy and Action Plan for 2050 to encourage all organizations to reduce their greenhouse gas emissions and adapt to the effects of climate change will be put into practice.
3) Regional Climate Change Action Plans will adapt our seven region to the impact of climate change. Smart city and zero waste practices will be expanded. New energy-efficient and climate-sensitive settlement areas will be established across Turkey.

4) A spatial strategy plan and new spatial plans at every scale will be put into practice to direct our investments in agriculture, livestock, tourism, renewable energy and industry which are most affected by the negative effects of climate change. The Zero Waste Project to be expanded to the whole country by 2023 will raise the waste recovery rate to 60% in 2035. Disposal of domestic waste in landfills will be terminated in 2050.
5) The rate of sewage treated into re-use will be raised from the current 2.5% to 5% in 2023 and 15% in 2030.
6) Renewable energy generation capacity will be increased. Renewable capacity will be raised to 10 GW and 16 GW respectively by 2030.
7) An Emission Trade System intended to support climate-friendly investments and reward the facilities investing in clean power generation technologies will be launched.
8) Power plants and industrial facilities will be provided with additional incentives to for climate-sensitive and environmentally-friendly production.
9) 25% less fossil fuel will be used in our buildings in 2023. Every building will be issued an energy identity certificate by 2030.
10) Public and private sectors will be provided with more incentives and funding for anti-climate change efforts and better access to international funding will be provided.
11) Reconstruction will not be permitted in areas under the risk of flood, landslide and soil erosion.
12) Suitable areas will be determined for relocation of the citizens living in such risky areas under expropriation and urban transformation projects.
13) Measures will be determined and taken for responsible use of water in cooperation with all relevant organizations for effective management and conservation of our water resources affected negatively by climate change.
14) A National Climate Change Research Center will be established. The Center will conduct scientific research with the National Climate Change Platform and make the studies and data related to climate change available to our stakeholders and organizations.

Although Turkey's roadmap for combating and adapting to climate change is quite ambitious, some of the challenges in renewable energy applications within the scope of this research have been identified as follows (Figure 3.3):

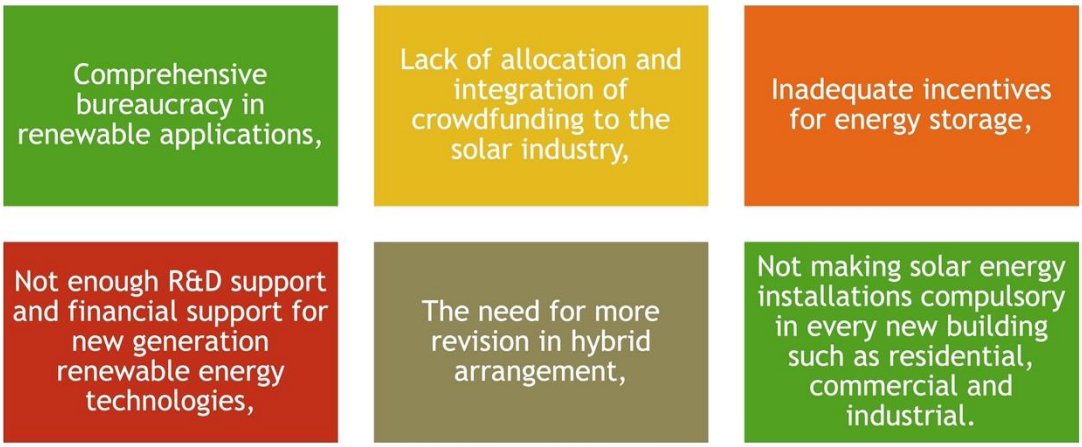

Figure 2Challenges for renewable growth in Turkey

Local energy systems will be included in the next section in order to use legislation, planning, accounting, reporting and auditing more effectively in the investment process, to rank expenditures according to local priorities and to ensure efficiency by making cost-benefit analyzes. Local energy models integrated with international networks will be examined in order to ensure a society-oriented and fair clean energy transition, where alternative financing opportunities can be found, too. In addition, practices for urban policies will be determined for renewable energy, especially solar energy, as the most suitable type for the use and access of households. The development process of energy communities which is the main application for renewable energy in Turkey's urban policies will be examined in the next section.

3.3. Community Energy in Turkey

In recent years, when the renewable energy has become widespread, many local governments have undertaken important projects in the fields of electricity production, lighting or agricultural irrigation. These efforts to make renewable energy use locally effective are not only for energy production; it also constitutes the road map of sustainable urbanization. In the climate action plans of various local governments, road map for sustainable urbanization with renewable energy sources are determined.

As can be seen in Turkey's renewable energy data, the most significant increases in installed power are in the fields of wind and solar energy. The investments of community energy in solar energy, which are within the scope of this research, are important because they are unlicensed installations. Unlicensed generation is seen as one of the main factors contributing to the increase in installed power capacity in recent years. The primary purpose of unlicensed production is to provide the necessary facilities for industry and residences to have the production capacity to meet their consumption. This mechanism was created to encourage domestic consumption for both households and industrial establishments. This is one of the main reasons why the activities for the energy of the community find a place to move especially from solar energy in our country.

3.3.1. Historical Development

Energy cooperatives, one of the most common uses of Community energy, dating back to the 2010s, when license-exempt electricity production began to be applied to the Turkish energy market. The basis of cooperative practices in Turkey can be traced back to ancient times. After the proclamation of the Republic, the necessary legal arrangements for the development of cooperatives continued to be made, and cooperatives, that is, partnership companies, were added to the commercial companies that were considered as collective, commanding, joint-stock companies in the Land Trade Law of 1850, which was in force with the Law No. 396 adopted on January 5, 1924. Thus, cooperatives were included in the law for the first time. In the Turkish Commercial Code enacted on May 29, 1926, cooperative companies were also included in the section reserved for capital companies (Ticaret Bakanlığı, 2019).

The establishment of a renewable energy cooperative in Turkey has been made possible with the 5th article of the "Regulation on Unlicensed Electricity Production in the Electricity Market" published in the Official Gazette dated 2 October 2013 and numbered 28783. Energy Cooperatives were defined in the Unlicensed Electricity Generation Regulation on March 23, 2016. With the addition made on October 22, 2016, the cooperatives with up to 100 members are up to 1 MW, the cooperatives with 101 to 500 members are 2 MW, the cooperatives with 501 to 1000 members are 3 MW, and the cooperatives with more than 1000 members are max. The right to establish a

facility to produce 5 MW of electricity has been given. Renewable energy cooperatives fall under the scope of unlicensed electricity generation and go through different phases with each new legislative change in this field.

The Table 3.3. below summarizes the legislation determined to affect the formation and development processes of energy cooperatives in Turkey:

Table 3.3. Legislation and regulations affecting energy cooperatives

Type	Date	Number	Name	Changes That Enactment Made	The Impact Of Regulation
Regulation	2/10/2013	28783	Regulation on Unlicensed Electricity Production in the Electricity Market	The purpose of this Regulation is in the electricity market; Within the scope of Article 14 of the Electricity Market Law dated 14/3/2013 and numbered 6446, meeting the electricity needs of consumers from the generation facilities closest to the consumption point, bringing small-scale generation facilities into the country's economy and ensuring their effective use in ensuring supply security, reducing the number of losses in the electricity grid. It is to determine the procedures and principles to be applied to real or legal persons who can produce electrical energy without the obligation to obtain a license and establish a company to establish a company.	Details were added to the unlicensed production, which found the opportunity to be implemented with the regulation published on 21 July 2011, with the regulation in 2013. In the electricity market, it was aimed to meet the electricity needs of consumers from their generation facility closest to the consumption point (self-consumption model), to bring small-scale generation facilities to the country's economy to ensure supply security, and to reduce transmission/distribution costs and loss amounts in the electricity grid with the distributed generation method.
Regulation	23/03/2016	29662	Unlicensed Electricity Generation Regulation	Energy Cooperatives are defined in the Unlicensed Electricity Generation Regulation on 23/03/2016.	With the regulation made in 2016, much support was given to Energy Cooperatives such as allocating special capacity at each transformer center and determining the applicable principles.
Regulation	22/10/2016	29865	Regulation Amending the Regulation on Unlicensed Electricity Production in the Electricity Market	The allocations to be made within the scope of the tenth paragraph for the generation facilities to be established based on renewable energy resources in the consumption combinations made for the facilities established through the renewable energy production cooperatives established under the Cooperatives Law dated 24/4/1969 and numbered 1163, within the scope of the Cooperatives Law dated 24/4/1969 and numbered 1163 It is determined in proportion to the number of members and consumption needs of the renewable energy production cooperatives established. In this framework, depending on the number of partners and not exceeding 1 MW, the installed power of the generation facility associated with each consumption facility; up to 1 MW for up to 100 partners, 2 MW for more than 100 up to 500 partners. Up to 3 MW can be allocated for more than 500 to 1000 partners, and up to 5 MW for those with more than 1000 partners.	With the stated regulation, the way for the establishment of renewable energy cooperatives in Turkey has been paved.

Table 3.3. (continued)

Notification	2/07/2018	30466	Communiqué on the Establishment and Articles of Association Amendment Transactions of Cooperatives and the Determination of the Number of Founding Partners and Working Areas	Renewable energy production cooperative: ARTICLE 12 – (1) Renewable energy production cooperatives are established by electricity consumption subscribers in the same distribution region and the same tariff group. (2) In renewable energy production cooperatives to be established by subscribers in the industrial and commercial tariff groups, the contract power of the partner with the highest contracting power can in any case be at most 20 times the contract power of the partner with the lowest contracting power. (3) If deemed appropriate by the Ministry, the rate determined in the second paragraph of this article may be increased for renewable energy production cooperatives that have created the necessary infrastructure and started to produce energy by combining consumption by the relevant legislation.	On 2/07/2018 a few limitations regarding their joint structure were defined. The changes made on this date are important in terms of showing the first example of the lobby formed for energy cooperatives.
Draft Regulation	1/11/2018	-	Draft Regulation on Unlicensed Activities in the Electricity Market	1/11/2018 Dairy products for Unlicensed Electricity Generation can be viewed in a text preparation. The right to establish multiple facilities for cooperatives is 5 Mtr. 5. The item can be sold to an unobtainable electric power. 11. it's one transformer does not have a capacity of 5 MW. 28. Fittings of all components of the articles.	Since all the rights introduced in 2016 are protected in the draft regulation, there has been a great interest in energy cooperatives. There are many important regulations on energy cooperatives in the regulation.
Regulation	12/05/2019	30772	Regulation on Unlicensed Electricity Production in the Electricity Market	The only regulation regarding energy cooperatives is on Article 29-Consumption Combination. In the production facilities established through renewable energy production cooperatives established under the Cooperatives Law No. 1163 and 24/4/1969, the legal entity of the cooperative is authorized without a consumption facility within the scope of the third paragraph. While all the producers had to be connected to a common meter, it was determined that the facilities were only suitable for roof and facade type use and land type applications were not allowed.	With the Regulation published on 12/05/2019, all old regulations and regulations were canceled and all definitions of Energy Cooperatives in the draft text were removed.

Table 3.3. (continued)

Regulation	9/05/2021	31479	Unlicensed Electricity Generation in the Electricity Market Amendments to the Regulation Regulation on	It was made possible to produce in a single region but to have partners from different addresses. In addition, with the 5.1.h regulation, those who had to install a roof type SPP with less than the consumption power can now install on the land, provided that it is limited to the installed power of the consumption facility. There is no requirement to connect from the same meter, but there is a condition that it is in the same distribution region. Real and legal persons were allowed to set up on the land within the scope of 5.1.c at the same measurement point as the consumption facility, provided that they do not exceed the contractual power for wastewater and drinking water treatment facilities and facilities for agricultural irrigation purposes.	With the Unlicensed regulation dated 9/05/2021, it was thought that the way for energy cooperatives could be paved. The decline in purchase guarantees, signs of insecurity about private sector investments, and uncertainties regarding the sharing of the network continue for cooperatives.

In 2014, the cooperative that received the first establishment permit was in Denizli Tavas, called "S.S. Aegean Electricity Energy Production and Consumption Cooperative. In 2018, the first to start operating was the Kayseri Furniture Manufacturers Renewable Energy Cooperative among the cooperatives that received the establishment permit. As of 2018, the number of cooperatives has reached 26. These cooperatives are located in Istanbul, Kayseri, Çorum, İzmir, Bursa, Amasya, Antalya, Afyonkarahisar, Elazig, Şanlıurfa, Çanakkale, Konya, Muğla and Aydın. Especially, Kayseri Furniture Manufacturers Renewable Energy Cooperative aims to generate 7.5 GWh of energy per year and the first phase of 5 MWp electricity capacity established on a roof area of 36,000 m2 (Ticaret Bakanlığı, 2019).

Similarly, Renewable Energy Cooperative in forest villages, the UN Development Program (UNDP) in Turkey, "Sustainable Financing Mechanism Project for Electricity Generation Solar Energy in forest villages", the dissemination of electricity production plants from solar energy has been established with the goal. The project is carried out in cooperation with the UNDP, the Ministry of Customs and Trade, the Ministry of Forestry and Water Affairs, the General Directorate of Forestry, the Department of Forest and Village Relations (ORKÖY), International Solar Energy Society Turkey Section-GÜNDER and the financial support of the Global Environment Fund (GEF). With ORKÖY PV Project, the renewable energy production cooperative has been established in four forest villages in Elazığ, Konya, Çorum and Afyon. In 2019, Within the scope of unlicensed electricity regulations, a large part of the project has been converted to rooftop solar energy applications (İklimhaber.com, 2019).

In Turkey, there is the Energy Cities Association (ETKB), which is responsible for supporting local governments practices in which renewable energy resources are predominant. ETKB was established in 1997 in accordance with the relevant articles of the Local Administration Unions Law No. 5355. It was established in the district of Kızılcahamam in Ankara as a public institution with a legal personality under the name of the Union of Municipalities with Geothermal Resources (JKBB). The Energy Cities Association include as of October 2019: 9 Metropolitans, 13 provinces, 92 Districts, 5 Towns; there are a total of 119 member municipalities (TSKB, 2020).

In Turkey's 11th Development Plan, it is stated that increasing the use of renewable energy should be encouraged through energy cooperatives (Kalkınma Bakanlığı, 2018). In parallel with the changes in the understanding of public administration in the world, states reduce their roles in the economic and social sphere, liberalize administrative, political and economic structures, and tend to meet the needs of societies with different economic models. Therefore, private sectors have started to make investments in many different economic fields such as education, health and renewable energy. In many developed countries, cooperatives, defined as the third sector besides the public and private sectors, emerged as self-help economic social solidarity organizations that assume their responsibilities and started to operate in all areas of the economy by filling the gap in the socio-economic field to a great extent. The increase in cooperative investments, especially in the field of renewable energy, has created alternative investment opportunities for the society in the energy market (Ticaret Bakanlığı, 2019).

In our interview with the official of REScoop.eu Belgium (Int-3), it has been stated that Turkey has tremendous opportunities to transition its energy system to a more secure, affordable, clean, sustainable and fair model. The cooperative movement in Turkey is growing and citizens are getting more and more involved. This progression is also visible in Turkish innovative policies aiming to support Energy Cooperatives. However, the cooperative movement in Turkey is still at an early stage. Looking at the Turkish policy landscape, major barriers for the development of energy cooperatives can be found in the restrictions around local production of renewable energy, the lack of capacity to feed-in over-production at a fair price and the difficult access to financing. Int-3 criticized that with the only copy-pasting policies from countries like Germany, the Turkish government will not be able to answer the needs of the local citizens. Moreover, the efforts of the cooperative movement to organise itself and to make a coherent and strong voice heard at the national level have not been successful so far. Despite those difficulties, it is clear that Turkish local and renewable facilities are growing and increasingly supporting each other and that will be examined in following part.

3.3.2. Related Local Activities

In Turkey, many municipalities make climate action plans, renewable energy action plans, sustainable development studies, and local carbon emission calculations. In this regard, many local governments are already doing much more willing and important works than national governments. However, such as actions, which will be made as a product of limited perspectives as a communication strategy, may contain the danger of turning into documents that are not transparent, that the responsibilities of the actions are not determined, that there is no possibility of implementation, and that it is difficult to monitor because the participation principle is outsourced (İklimhaber.com, 2021). Also, the legislative and economic constraints can negatively affect progress. Nowadays, the most important need of local governments in renewable energy projects is at the point of finding financial resources. After the invitation letters received by the municipalities to generate energy from the sun are completed, the main issue is finance. The table can be found in **Annex-1** shows some of the municipalities that want to develop solar energy projects through such as Ilbank, development agencies, tenders or equity capital by the study conducted a company called Actus Solar, working on unlicensed SPP financing. As seen on **Annex-1**, there are projects of municipalities identified, but they could not be implemented for a long time due to lack of financing opportunities or due to regulatory intensity and put on hold.

In this section, interviews were held with the municipal officials, non-governmental organizations and energy cooperative representatives. There are some community energy practices in Turkey which are implemented as cooperatives or with the unions formed by municipalities. During 2019 and 2020, the different cooperative representatives from Turkey were interviewed via e-mail and the details were clarified with phone calls. An interview was held with an authorized person via e-mail about the importance of energy cooperatives in Europe. In order to learn the application areas of green energy in local governments, the video recording of SolarTR International Conference and Exhibition which hosted the municipalities session in 2018, was watched and detailed information was obtained through phone calls (GÜNDER Solar, 2018).

According to the information of Int-1 from the Furniture Manufacturers Renewable Energy Cooperative, the first phase of the investment of cooperative ensured the 30 percent of the facilities' daytime consumption with 7.5 GWh electricity generation annually. For the project, 18.000 pieces of 325 W panels were placed, and an installed power of 5.8 MWp was reached on a roof area of 36.000 m2 and, the Cooperative both saves energy and saves 22,294 trees.

In our inteview with Int-1, it has been emphasized that with the principle of consuming energy where it is produced, electricity is produced primarily for needs and the surplus is sold to the government. 6 million 300 thousand dollars plus VAT (7.2 million dollars) were invested in the facility, and there is an incentive certificate for VAT. As the data obtained from Int-1, and comparing the productions in 2019-2020, it is seen that there is an excess production of total 5 SPPs; 48.536 KWh. This production corresponds to the consumption of approximately 8 thousand houses. It is seen that 105 megawatt-hours (MWh) of production goes to the cooperative's electricity consumption, while 15 percent of the average production goes to domestic consumption. In our inteview with Int-1, it has been emphasized that with the principle of consuming energy where it is produced, electricity is produced primarily for needs and the surplus is sold to the government (Figure 3.4).

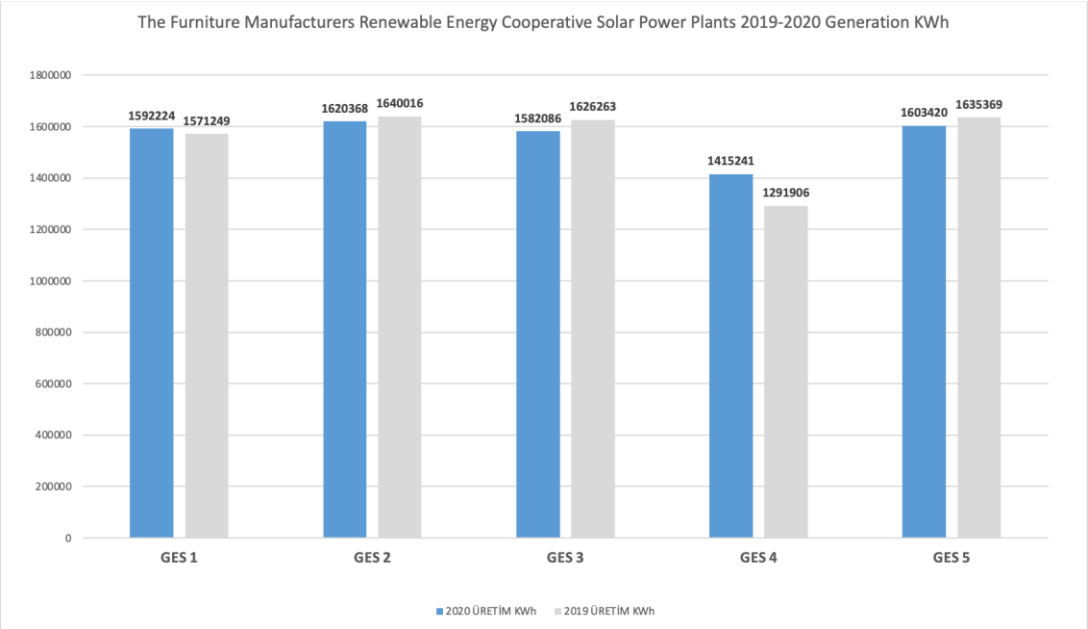

Figure 3.4. The furniture manifacturers renewable energy cooperative solar power plants generation, 2019-2020 (kWh)

In order to understand the place of energy cooperative, one of the most important types of community energy, there are some semi-structured interviews with non-governmental organizations and municipality officials working for the development of community energy.

In our interview with Int-2 from Troya Environmental Association, it has been emphasized that the first examples of cooperatives emerged in the United States with the community efforts of settlements that are far from the distribution grid and do not receive electricity due to high investment costs. Int-2 mentioned that this model has also shown itself in the developed Western European countries after the oil crisis in 1974. While the search for new energy production ways as an alternative to natural gas used for heating especially in Northern European countries continues, central systems have started to be tested and developed in these countries. While the first examples of cooperatives developed in this area, the same community-based production methods were tried for the rapidly increasing electricity demand, and the first renewable energy cooperatives were implemented in the early 1980s.

The opportunities that an energy cooperative can provide to local people, local governments and a country in general have financial, social and environmental implications. Int-2 underlined the local development:

> Renewable energy cooperatives should be seen as communities coming together to meet their electricity needs. This is an enterprise model. It is the fact that the community come together in different areas with their own geographic characteristics and skills and invest money in that cooperative as in a company model. By integrating the community into the system, it is to ensure that they earn money while meeting their needs. Since they are not big investment models, they are more based on efficiency and trust. Energy efficiency is extremely high. Because the saved energy is guaranteed in sales. It is local because it was established by people living within a certain geographical boundary. It has a positive effect on local development as it focuses on local investment.

On the other hand, it is not correct to view renewable energy cooperatives as non-profit structures. Int-2 summarized the logic of the system:

> Because cooperatives need to get a positive step in order to meet the needs of their partners while meeting their expenses in a sustainable way. This can happen with a certain rate of profit. However, cooperatives are more social structures than companies. The basic requirements in this regard are the introduction of this model, which is not known enough in our country, with best practices and the development of the missing legal legislation with a participatory model. For this we need a model that brings together legislators and already established energy cooperatives. Perhaps

> the leadership of NGOs and similar industry institutions will create a positive development here.

One of our interviewees 8Int-4) from Denizli Bozkurt District Municipality, explained the decision-making process and financing plans for solar energy projects. Financing was provided from İlbank and an assignment agreement was signed between the distribution company and bank. With this assignment agreement, 30 thousand lira of this invoice, which we charge to the state every month over the sale price to the state, which is 13.3 cents, is offset by the Iller bank. In our interview Int-4 stated that the summer of 2018 was very productive and they had bills of up to 190 thousand lira. The last bill was 139 thousand liras and 30 thousand liras of this amount was paid to Ilbank, and what remains is a very efficient amount for a small municipality like Bozkurt. It has been highlighted that Turkey's solar potential map showing the potential of the district is very high, and how local governments can benefit from power plant installation related to solar energy is a long and difficult process and it has a lot of difficulties in terms of legislation.

In Bozkurt Municipality, they use solar energy not only for the roof, but also in the field of agriculture, farming and especially in agricultural irrigation. They had meetings with 2 banks lending in this area. One of them is Ziraat Bank, which is a public bank, and the other is Denizbank, a private bank. It has been mentioned that the loan rates in renewable energy are around 9-10%. For Int-4, the solar energy is highlighted to be used in agricultural and dairy cooperatives:

> A farmer did not even know about these interest rates, which can rise up to 20% under normal conditions. They have nearly 90 agricultural development cooperatives and, as a municipality, we have been a guarantor for solar energy to be used in agricultural and dairy cooperatives by meeting with bank managers. Today, we have 7-8 guarantors who have a very good return. Citizens who saw that using solar energy in agricultural irrigation are much more profitable also supported us.

In Turkey, the Union of Municipalities of Turkey (TBB) has 1000-odd active depending on the municipalities. Bozkurt Municipality to share their experiences and let other municipalities not experience the difficulties they have, due to the problems in the legislation. As a renewable energy or solar energy union, they shared the experiences with each other and applied to the Union of Municipalities with the understanding that unity is strength. In the next period, they hope to complete the work

for the sun-friendly union of municipalities. They continue the works with both commercial and normal cooperatives up to 3MW.

Since the zoning authority, which is the facilitator for local governments, is in the municipalities, it has been a method facilitated by the municipalities in local governments to solve the works in 1/5000 and 1/1000 plan. The power plant in Bozkurt Municipality has 4,158 panels, 40 inverters and a remote monitoring system. Now, they are working on more power plants. Moreover, they wanted to inform the citizens, provide convenience and pave the way for installing solar energy panels on all roofs. They decided not to obtain a building permit from all construction owners who will put solar panels on their roofs. They made a decision as the city council and facilitate the citizen's work for new and old buildings in the zoning offices.

Also, in our interview with the Project Specialist of Gaziantep Metropolitan Municipality (Int-5), it has been stated this is not only about renewable energy projects, it is about a sustainable urbanization. The greenhouse gas emissions in the Gaziantep Climate Change Action Plan prepared in 2011, it has been showed that the industries have the biggest share and then the huge share is housing in electricty consumption. Carbon neutralization studies have begun to reduce carbon and other gases resulting from greenhouse gas emissions.

The renewable energy applications of Gaziantep Municipality as follows:

- 1 MW SPP made by GASKI,
- 3 MW project by Gaziantep Municipality, Department of Technical Affairs,
- GASKİ the same time, 120 KW / h Turkey has the largest solar car park.
- 1 MW biogas plant as renewable energy
- Facility with the impact of water in GASKI's wastewater treatment plant
- There is a facility that produces electrical energy from methane gas

The Municipality of Gaziantep is also working on energy efficiency buildings. First of all, it started from their own public buildings and the energy efficiency and insulation level of the Gaziantep Municipality building were increased and various arrangements were made in the building with a high cooling load. Lighting was improved and BREEAM certification was obtained. The municipality has an ecological city project

completed in 2010, and an ecological building was built in 2014 to set an example for this. It is aimed to make future buildings like this building and ecological city projects. They are actively using this building. Its main features are as follows:

Turkey's first "passive house" has been called, greets energy from renewable energy and 90% energy savings compared to the reference it provides a building in Gaziantep. Green roof systems available and gray water treatment system. There are 84 240-watt solar panels in its garden. In our interview with Int-5 from Gaziantep Municipality, it was mentioned that they generate more energy than they always consume at the end of the year:

> We have an annual profit of over 5 thousand TL only from energy. The building is environmentally friendly and produced entirely with local materials. Special insulation system is used. Since the passive house certification system is obtained from Germany, this requires a superior insulation. A system to not miss energy and use energy efficiently. Sealing minimum, an insulating said on the standard TS 825 Thermal Insulation Rules in Buildings in Turkey; on windows, walls and roofs and floors.

Also, there is a workshop to teach the children, youth and adults about the foundations of sustainable and ecological life, and primarily to change consumption habits, the importance of renewable energy and the dangers posed by fossil fuels in our lives. There is a workshop part connected to the ecological building. As the ecological city design branch office, they make some applications that will change the city and create a certain perception in people. It has been mentioned that the primary support expected from the authorities in the field of renewable energy is financing.

3.4. Concluding Remarks

In urban settlements where more than 90 percent of the population live (TÜİK, 2021), local governments are taken care of the social interests in planning, design and implementation related to energy. Today, the primary duties and responsibilities of local governments to diminish the effects of air and environmental pollution of fuels used in transportation and heating to human and community life, as well as to transition to applications that can reduce the costs of electricity consumed.

In provinces where electricity demand and urbanization are in direct proportion, the emission of carbon and other gases due to greenhouse gas emissions in the specified

areas of use increases. This necessitates that carbon neutralization studies should be applied primarily locally in order to reduce emissions. Provinces with metropolitan municipality are at the center of the target of reducing energy-induced carbon emissions with local practices for renewable energy sources, primarily for industry, commercial and residential use.

For the renewable energy practices of local governments, which are the focuses of the thesis, it seems that producing energy from renewable sources with the community energy method where the energy will be consumed by the local people, thus reducing the loss rates in the energy system, obtaining economic value by selling the produced energy to electricity distribution companies and spreading the capital to the base, providing employment, contributing to local development, ensuring that the society has a say in energy, preventing monopolization in energy. Energy costs, clean energy production and environmental impact of fossil resources, and lowering the energy dependency rate of the country are among the aims of renewable energy cooperatives.

One way to produce energy without depending on fossil fuels is through renewable energy cooperatives. It has also been determined that the energy cooperatives formed by the gathering of citizens create social benefit while producing cheap, clean and locally focused energy. Cooperatives form the basis of energy democracy by supporting the production of energy where it will be consumed, the control of energy by local communities, and sustainable local development. Generating electricity from solar energy, which is one of the climate-friendly solutions that will reduce dependence on fossil fuels, is also encouraged by the public.

As discussed in the section above, community energy projects are available in various forms and the most common involve generating energy. In addition, small biomass plants, heat pumps, solar and district heating networks are leading technologies for some community groups. However, practice differs in each country, as energy communities are so heterogeneous in organizational models and legal forms. Government structures, legislative systems, National enabling frameworks, Geographical scope, Activities, Participants, Autonomy, Effective control are the main structural differences. Renewable energy communities differ on these issues, and so the most common type has been energy cooperatives established from the outset of

renewable energy support programs. Limited partnerships, development agencies, associations, and foundations represent the types that support citizens' participation in renewable energy sources (JRC, 2020).

As a result of interviews with industry experts, the municipalities invest the most in solar energy in the field of renewable energy. The most involved activities in electricity consumption within the municipality boundaries: Agriculture, Recycling Solid Waste, Heating, Lighting, House type. The ratio of the annual electricity costs of the municipalities to the annual budget is between 25-50 percent. Financing resources used by the municipality for renewable energy investments; in the first two places are Ilbank, equity capital. Then, Private Banks, European Union Grants and Funds, Public Banks. Comments on all these issues will be discussed in the next section. Turkish policy landscape, major barriers for the development of energy cooperatives can be found in the restrictions around local production of renewable energy, the lack of capacity to feed-in over-production at a fair price and the difficult access to financing.

It has been determined that the energy cooperatives, which were paved with the legislative changes made in the 2016-2021 period, reached 30 in 2017. While this number reached 48 in 2019, 8 of them reached their electricity generation target; the remaining cooperatives could not be active due to financing, bureaucracy, and production problems. (Int-2 meeting notes) With the draft regulation published in 2019, these initiatives, which are observed to provide great opportunities for the future, have entered a great deadlock by not allowing consumption combinations and land type installations with the legislation published in the same year. After 2 years, the sector grew with incentives such as private sector investments and YEKA tenders, and with the arrangement made in 2021, it became possible for partners from different addresses to produce in a single region. The most critical feature of the unlicensed electricity legislation in this period for the cooperatives is that the newly established solar energy investments were made for self-consumption and their income-generating feature was left in the background.

Table 3.4. Country ratings for community energy structures (author's evaluation)

Rating Criteria	The UK	Germany	Canada	Denmark	Poland	Turkey
Legislative system	2	5	4	5	1	2
Support mechanisms	1	3	4	4	1	1
National enabling frameworks	2	4	3	5	2	1
Planning procedures	2	4	3	4	1	2
Number of Participants	3	5	3	5	2	1
Local energy activism	2	5	4	5	1	1

Excellent = 5, Very Good = 4, Good = 3, Fair = 2, Poor = 1

The regionally differentiated structure of urban policies and similar examples around the world can support Turkey's local governments in making a proposal based on community energy. The rating above (Table 3.4) was made on the basis of the community energy practices of the countries in the previous section and identifies some of the areas for improvement. In this research, the community energy practices in different countries were examined with the understanding that each country's public administration systems and local governments may have different or similar aspects. It is accepted there is no common legislation, economic opportunities or motivation to advance demand-oriented localization and the local practices include regional differences, and activities for community energy are includes regional differences. Several countries that are selected based on specific criteria in order to cover several most of the cases based on their legislative system, support mechanisms, national enabling frameworks, planning procedures, number of participants and local energy activism. Renewable energy communities differ in these subjects and for this reason, countries such as Denmark, Germany, UK, where more common and successful examples are located in Europe, as well as Poland where applications have only recently increased, and Canada as a different continent was analyzed.

The main trigger of the development process, especially in countries that have implemented community energy long ago, is fair payment for system costs, supporting framework, sharing of power generation over existing network, rights and duties according to roles in the energy sector (producer, collector, user, etc.), possible

ownership or lease of the network. However, it should be underlined that even in the best practices of these countries, there may be decreased purchase guarantees for community energy applications, signs of insecurity according to private sector investments and the desire not to share the grid. For this reason, initiatives towards community energy are increasing in order to increase social awareness and develop joint efforts all over the World.

The “Case Study” is the fourth chapter of the thesis. A case study called Yalova Wastewater and Sewerage Infrastructure Operation Association (YASKI) Solar Energy Project which is a union of municipalities, has been examined in detail from the installation process to its production and financial studies.

CHAPTER 4

THE CASE STUDY

In this chapter, a case study has been examined in detail. Yalova Waste Water Treatment Plants and the Sewage Making and Operation Union (YASKI), which is one of the best examples of community energy applications of local governments in Turkey. It is one of the solar energy projects implemented with the cooperation of municipalities. YASKI Solar Power Plant, which started its operations with the union of municipalities, was determined as a case study. As a result of the interviews with Int-7, Yalova Municipality in March 2021, the technical, economic and regulatory information regarding the establishment process of the power plant will be presented.

4.1. Introduction

YASKİ produces one third (1/3) of the energy consumption with 3 thousand 360 solar panels installed on the treatment pools. With the system, which was built by a company 15 months ago and cost 6 million lira, the facility, which has saved 1 million lira in energy in the last year, has also sold 120 thousand lira of income by selling its excess energy. In 2019, YASKI Union Presidency Solar Power Plant Project was pre-accepted, the grid connection was completed and the plant was commissioned for a ten-day trial period. In the following period, it is aimed to reduce energy costs by compensating approximately one third of the energy consumption during the year.

With this study, Yalova Wastewater Treatment Plants and Sewerage Making and Operation Union (YASKI), of which Yalova Center, Çiftlikköy, Taşköprü, Termal and Kadıköy municipalities are the founding members of the municipalities, are able to meet the electrical energy requirement of the Wastewater Treatment Plants operated by the Union from solar energy with the help of photovoltaic panels. It is the technical and financial examination of the power plant established for financing. In line with this purpose, the solar energy potential of the study area where the panels will be placed was determined and cost and suitability assessment was made.

Yalova Wastewater Treatment Plants and Sewerage Making and Operation Union (YASKI) is an Association established under the Law No.5355 of Local Administration Unions, of which Yalova Central, Çiftlikköy, Taşköprü, Termal and Kadıköy municipalities are a founding member. The Advanced Biological Wastewater Treatment plant operated by the Union has an installed capacity of 100,000 m3 / day and is located in Bahçelievler Mahallesi in Yalova city center.

Renewable Energy from the General Directorate Turkey Solar Energy Potential Atlas (GEP) 's by YASKI's Wastewater treatment total radiation of Yalova central district where the units (kWh / m2yıl) and sunshine duration values are shown in the following figures (Figures 4.2, 4.3 and 4.4). With the Lynx Planner Program, the global radiation value of the Central district of Yalova province is calculated as 1.344 kWh / m2 and the total annual sunshine duration is 2.411 hours.

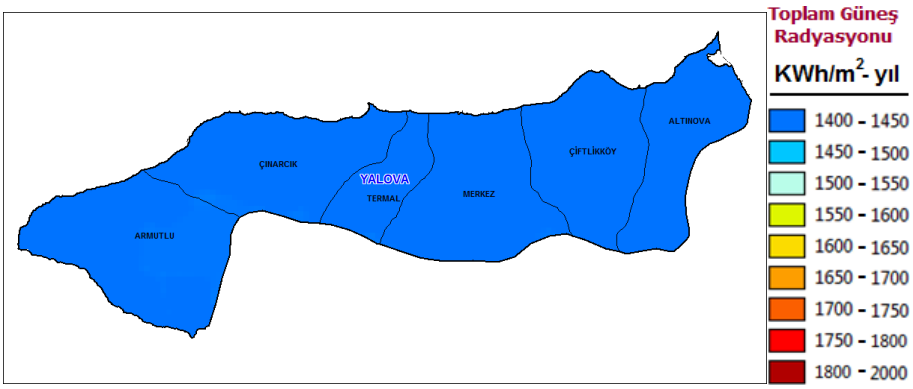

Figure 4.1. Yalova province central district global radiation map (MGM, 2020)

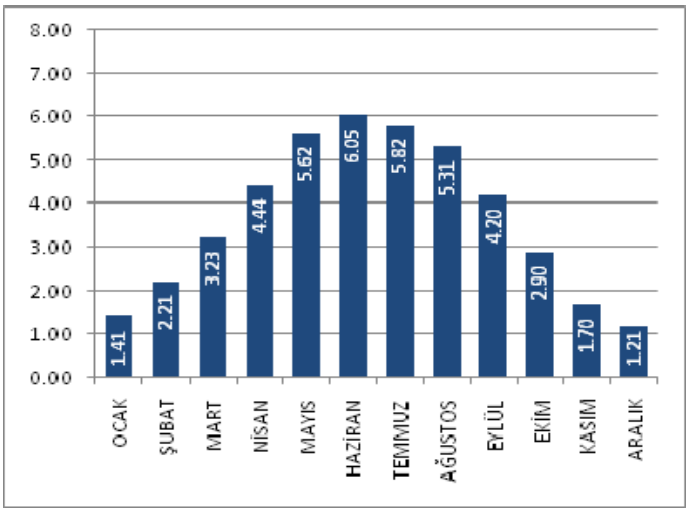

Figure 4.2. Yalova province central district daily radiation values according to months (Kwh / M²)

4.2. Selection of Land to Install Solar Panel

For the realization of the project, it has been deemed appropriate to use a piece of approximately 20,000 m2 of the 78,156 m2 plot, which is owned by YASKI and includes Wastewater Treatment Plants. The area where solar panels will be placed is located in Bahçelievler Quarter on the west side of the central residential area of Yalova province (Figure 4.2). The plot is slightly south inclined. It has been determined that this ~ 20.000 m2 area with a photovoltaic surface area of 6.494 m2 will not be shadowed by solar panels (shadowing structural and topographic factors reduce energy production) and will be placed facing south.

By determining the lower and upper point levels of the solar panel carriers to be resistant to the wind and snow load of the region, the poles are directly nailed into the ground in order not to cause the solar panel carriers to tilt, dislocate or slide on the ground, and the periphery of the places where the panel carrier legs will be placed. concreting has been provided. In addition, the aluminum legs that will hold the solar panels are designed so that the panels will not be covered by snow in winter conditions in the region. Measures (using gravel etc. materials) have been taken to prevent the growth of weeds in the field. Experts determined that Solar Modules and their fasteners must have wind resistance with a capacity of 130 km / h.

Solar Panel Installed Area Information:

EUR50 Coordinates (6o UTM):
688 533 D 4 502 351 K;
688 589 D 4 502 398 K;
688 614 D 4 502 369 K;
688 657 D 4 502 402 K;
688 746 D 4 502 303 K;
688 648 D 4 502 219 K;
688 559 D 4 502 324 K;
688 549 D 4 502 335 K;
688 539 D 4 502 345 K;

Altitude: 9-13 m.

Average temperature: 14.2 ° C (Average temperature for many years) Solar Irradiance: 1.344 kWh / m2 / year (GEPA)

Field size: 78.156 m²

Solar Panel Surface Area: 6.494 m2 (for 4000 solar panels) Mounting System: Free Ground (Open area)

Figure 4.3. Satellite image of YASKİ wastewater treatment plants SPP project site area

4.2.1. Facility Consumption Information

The annual electricity consumption of YASKI Wastewater Treatment Plants is 2.335.287 kWh (Table 4.1). Accordingly, it is recommended to establish a 1 MW photovoltaic solar energy system in order to meet some of this amount, which is the self-consumption of YASKI Wastewater Treatment Plants. Panel and inverter information that can be used according to the calculations are given below.

Table 4.1. Solar panel information

Type	Pollycrystalline Silicone
Power	250 W
System Voltage	37.3 V
System Current	8.36 A
Sizes	990mm-1640mm-40mm
Weight	19.1 kg
MOQ	4000
Total Panel Power	1 MW Tilt: ~ 30 °

Table 4.2. Inverter information

Power (AC)	10 kW Number of Inputs (MPP) 2
Efficiency	99%
Nominal DC Voltage	715 V
System Current	12 A
MOQ	100
Output AC Voltage	3 Phase 380 V (directly connected to the network)

Transformer Features

For the Solar Power Plant to be installed, a transformer with a minimum power of 1250 kVA and a voltage of 34.5-0.4 kV was required.

4.2.2. Financial Analysis

For the Solar Power Plant project built for YASKI Wastewater Treatment Plants, the "payback period" method, which does not take into account the time value of money, and the "net present value and internal efficiency (internal profitability / internal return) ratio" method, which takes into account the time value of money. In financial analyzes, it was stated that the investment amount was 100% loaned by Iller Bank.

Payback Period Method

The annual electricity consumption of YASKI Wastewater Treatment Plants is 2,335,287 kWh. In order to meet some of the electricity consumption of YASKI Wastewater Treatment Plants, 1 MW of installed power has been proposed and it has been calculated that the system will generate 1,210,078 kWh / year energy for the first year. € / TL parity has been accepted as 3.30. It has been accepted that the € / TL parity will increase by 5% each year. It has been assumed that the sale price of electricity increases by 5% each year and electricity generation will decrease by 0.5% each year.

The land required for the establishment of this facility is ~ 20.000 m². The economic life of the facility was accepted as 25 years, and the total investment amount was calculated as 3.980.000,00 TL. It is envisaged that the total investment amount will be covered by the Bank loan. The ratio of the photovoltaic system to be established to meet the electricity consumption of YASKI Wastewater Treatment Plants is

approximately 52%. All of the energy generated by the solar power plant will be offset and the sale price of the electricity to be offset is calculated from 37 kurus.

Installation Cost

For the facility installation cost, the PV panel, inverter, synchronization system and the area were prepared and fenced, and the calculation was made from the unit kWh prices for the installation of the system (Table 4.3). The cost of electricity facilities (Transformer cost, possible power transmission line construction) is included in the calculations, and the land and expropriation cost are not included.

Table 4.3. Installation cost account

MATERIAL / JOB NAME	**UNIT**	**QUANTITY**	**AMOUNT**
SYSTEM INSTALLATION COST			
System Installation with PV Panel, Inverter, Synchronization System, Land Preparation	€/kW	1.200	
PV Installed Power	kW	1000	
System Installation Cost	€		**1.200.000,00**
	TL	3,30 TL/€	**3.960.000,00**
COST OF ELECTRICITY FACILITIES			
Discovery of Medium Voltage (MV), Energy Transmission Line, Transformer and Low Voltage (LV) Panel	TL	Piece	0,00
Energy Transmission Line Construction (Calculated According to Energy Allowance	TL	Lump sum	0,00
Other Electrical Facilities Project and Construction (Grounding, Camera, Lightning Rod etc.)	TL	Lump sum	20.000,00
TOTAL	**TL**		**20.000,00**
LAND AND EXPROPRIATION COST			
Since it will be solved by the municipality, it is not included in the additional cost calculations.	TL		0,00
TOTAL	TL		**0,00**
ACILITY INSTALLATION COST			
SYSTEM INSTALLATION COST	TL	1	3.960.000,00
COST OF ELECTRICITY FACILITIES	TL	1	20.000,00
LAND AND EXPROPRIATION COST	TL	1	0,00
GRAND TOTAL	TL		**3.980.000,00**

Operating expenses

The existing facilities of YASKI were used to operate the facility. In the first year, approximately 19,900.00 TL (0.5% of the System Installation Cost) is foreseen for the operation maintenance and repair.

Depreciation Account

25-year depreciation has been calculated for the Solar Power Plant to be established, and the annual depreciation is given in Table 4.4.

Table 4.4. Depreciation table

TOTAL INVESTMENT COST			**3.980.000**
VAT (-)			**0**
INSURANCE (-)			**0**
EXPROPRIATION (-)			**0**
WORKING CAPITAL (-)			**0**
AMOUNT BASED ON DEPOSIT			**3.980.000**
DEPRECIATION			**159.200**
YEARS	**DEPRECIATION**	**YEARS**	**DEPRECIATION**
1	159.200	14	159.200
2	159.200	15	159.200
3	159.200	16	159.200
4	159.200	17	159.200
5	159.200	18	159.200
6	159.200	19	159.200
7	159.200	20	159.200
8	159.200	21	159.200
9	159.200	22	159.200
10	159.200	23	159.200
11	159.200	24	159.200
12	159.200	25	159.200
13	159.200		

Proforma Income Statement

The Proforma Income Statement, which is calculated assuming that energy production will decrease by an average of 0.5% each year and that the operating expenses and electricity sales price will increase by 5% each year, has been prepared considering the 25-year economic life of the investment.

Within the scope of the project of obtaining some of the electrical energy consumption of YASKI Wastewater Treatment Plants from solar energy with photovoltaic panels, the annual electricity generation of the power plant with an installed power of 1 MW is predicted to be 1,210,078 kWh according to the calculations made for the first year.

In the event that 1,210,078 kWh of electricity, which is the annual electricity production value of the power plant for the first year, is purchased from the distribution company, the total net cost to YASKI (when 1 kWh is taken as approximately 38.57 kurus) is 466,727.08 TL.

The total net relative income of YASKI from the production of the power plant is predicted to be 466.727.08 TL for the first year.

The total installation cost of the system is estimated to be 3.980.000,00 TL, and if this amount is covered by a 10-year loan from a foreign source, the annual interest rate is taken as 7%, and the loan to be used will have a fixed repayment of 554.534,00 TL per year for 10 years.

When the investment is made with foreign resources with a maturity of 10 years and an annual interest of 7%, it will be able to finance the annual fixed repayment amount of 554.534,00 TL after the first 5 years (with an additional payment of 106.805.00 TL for the first year) with its own production income in 10 years.

4.3. Conclusion

The YASKİ SPP project, the world's largest solar energy project in terms of installed power on pools realized by Yalova Wastewater and Sewerage Infrastructure Facilities Operation Union (YASKİ) and YP Energy, has been completed. YASKI, which treats all of Yalova's residential wastewater and delivers the to the sea with a deep discharge system, has developed a project to reduce energy costs, which is the biggest expense. It is a first in Turkey within the scope of the project, refining the 3 thousand 360 solar panels placed on the pool. With a capacity of 1 MW, the provisional acceptance of YASKI Union Presidency Solar Power Plant Project was made as of 05.08.2019.

For the Central district of Yalova province where the Wastewater Treatment Plants of Yalova Wastewater Treatment Plants and the Sewerage Making and Operation Union (YASKI) are established, the Global Radiation Value is calculated as 1.344 kWh / m2-year and the sunshine duration as 2.411 hours.

The annual electricity consumption of YASKI Wastewater Treatment Plants is 2.335.287 kWh. Approximately 52% of this consumption can be met by installing a 1 MW solar power plant. Solar panels have been placed on a photovoltaic surface area of 6.494 m2 of the approximately 20.000 m2 area determined within the 78.156 m2 parcel area owned by YASKI. For the connection of 1 MW GES to the national grid, a transformer with a minimum power of 1250 KVA and a voltage of 34.5-0.4 kV was found.

By providing a part of the electricity consumption of YASKI Wastewater Treatment Plants with solar energy, increasing the use of the renewable energy resources, 725,331 kilograms of carbon is prevented from emitting into the atmosphere annually. In this way, by increasing emission absorbing areas, greenhouse gas emissions are reduced and a significant contribution is made to combating climate change, desertification and erosion in the national sense.

In accordance with the "Regulation on Unlicensed Electricity Generation in the Electricity Market" for connection and system use,

a) The title deed or the lease contract or other document indicating the right of use and the receipt or receipt indicating that the application fee has been deposited into the account of the relevant network operator, the project study report sent to the municipality and its annexes (single line scheme and general layout plan) Unlicensed Generation Connection Application Form was filled and the license for Unlicensed Electricity Generation Connection was obtained from the electricity distribution company to which it is affiliated.
b) The relevant Network Operator has sent an invitation letter to the connection agreement by announcing the result of the evaluation of the applications examined within this scope and the connection proposal, if any, for the applications whose connection point is not found suitable, on the website for 1 month.
c) After the invitation letter is sent to the connection agreement, a period of 180 days has been given as of the date of notification, within the first ninety days of the said period, the generation facility and the liaison line project, if any, have been submitted to the approval of the Ministry or the institutions and / or legal entities authorized by the Ministry.
d) The "Connection and System Use Agreement" has been signed with the necessary documents within 30 days of the application of the production facility whose project has been approved to the relevant network operator.
e) The production facility connected to the system at the High Voltage level was commissioned and completed within 2 years.
f) The facility was commissioned with the provisional acceptance of the Ministry.

In Turkey, the investments of local governments have rised with the decrease in renewable energy costs and the supports provided by Iller Bank in Turkey. Due to the lack of energy efficiency practices in public institutions, local governments in particular have increased their investments in renewable energy sources, which are rapidly developing technological developments as an alternative to high energy bills. The positive effect of the European Union projects cannot also be denied. In this way, the opportunity to see the practices of local governments in their places has increased. The source of the contribution provided by the European Union projects is due to the fact that the background of studies on community energy is more common in that continent. These evaluations point to the conclusion that local governments do not have sufficient resources to fulfill their roles in local economic development. It can be combined with the following suggestions on the last chapter, together with the financial autonomy required for municipalities to increase their financial resources and use them more effectively.

CHAPTER 5

CONCLUSION

5.1. Conclusions

The results of this study highlight the importance of cities involved in energy studies with community energy practices. For this reason, it is necessary to determine the content of the duties and responsibilities of public authorities, the private sector, and non-governmental organizations in the policy-making process. The basic requirements for "Community Energy Planning in Decentralization Policies", which can be supported by support mechanisms, national activation frameworks, increasing the number of participants, and local energy activism, are identified in Figure 5.1.

Figure 5.1. Requirements for community energy planning in decentralization policies

In this study, it has been determined that energy communities differ in terms of organizational models and legal forms. It can be underlined that even in the best practices of the countries, there may be decreased purchase guarantees for community energy applications, signs of insecurity according to private sector investments and the desire not to share the national grid. For this reason, some points are emphasizing energy storage technologies in order to renewables can play a role in reducing this dependency for a national grid.

When the community energy is considered as a part of urban policies in Turkey's local governments, it has been defined there are some purposes such as reducing energy costs, generating income through the sale of excess production to the grid, or meeting climate targets. The renewable energy sector in Turkey has made progress with the government's incentives for private investment. It is observed that legislation changes frequently and financing opportunities for private sector investors are prioritized. The pressure of economies of scale is created within the market structure provided by privatizations, and the general understanding that costs decrease with larger investments is dominated. The local applicability of investments such as solar energy, which are open to household participation and can be efficient on a smaller scale, is decreasing.

There are many applications where local governments want to be included in renewable energy capacity. It has been determined that the issues of legislation, financing and expert employment are critical for such renewable energy facilities, which can be powered by practices to meet local demand that ensure joint participation of the public, such as community energy. This capacity race provided by privatizations is an obstacle to local energy practices in Turkey. Community energy practices are considerable for local governments to gain financial strength, contribute to national climate efforts, and provide local people with access to energy at a more affordable price. In these practices, the localization and privatization efforts of all these parties involved in energy-oriented public policies are significant. The concept of localization, which is stated to cover all political, administrative and social activity areas of the society, also includes renewable energy applications in terms of urban policies.

For the renewable energy practices of local governments, which are the focuses of the thesis, it seems that producing energy from renewable sources with the community energy method where the energy will be consumed by the local people, thus reducing the loss rates in the energy system, obtaining economic value by selling the produced energy to electricity distribution companies and spreading the capital to the base, providing employment, clean environment and preventing monopolization. Energy costs, clean energy production and environmental impact of fossil resources, and lowering the energy dependency rate of the country are among the aims of community energy.

Within the scope of the study, the transition to local energy systems, it is accepted that there is no common legislation, economic opportunities or motivation to demand-oriented localization and that the practices include regional differences. It has been observed that best practices in different countries are supported by support mechanisms, national enabling frameworks, the increase in the number of participants and local energy activism. These efforts to make renewable energy use locally effective seems not only for energy production; it also constitutes a road map of urbanization with renewable energy sources. The concept of localization, which is stated to include all of the political, administrative and social activity areas of the society, also includes clean energy projects in urban policies.

In Turkey, the central government states as a regulator, renewing the legislation or offering incentives and private sector investments act in accordance with these regulations. Moreover, the many of the policies that non-governmental organizations try to influence the regulations with their lobbying activities such as private sector companies or very few influence for the community energy practices. In the development process of the electricity sector in Turkey, incentive mechanisms for fossil fuels and renewable energy sources have been developed within the scope of ensuring electricity supply security and increasing the electricity produced from renewable energy sources. While energy activities have a place for action in this structure, they require to be examined as a public policy issue, and from the perspective of local governments, they are evaluated as an actor of energy planning to ensure decentralization and autonomy. For this reason, the concepts of localization and privatization are examined in this study. Comparing the capacity of private sector investments in Turkey with the capacity of community energy studies, it has been determined that the issues of legislation, financing and expert employment pose challenges for local practices.

When community energy is considered as a part of urban policies in Turkey's local government system, it has been determined that objectives such as reducing energy costs, generating income through the sale of excess production to the grid or meeting climate targets are on the agenda. The guiding principles for citizens energy communities in the EU are supporting framework, sharing of power generation over existing network, fair payment for system costs, rights and duties according to roles in

the energy sector and possible ownership or lease of the network. In addition, the Clean Energy Package (EU Commission, 2019), which introduces innovations for consumers by recognizing the right of citizens and communities to participate directly in the energy sector, has established legal frameworks for certain types of community energy: Governance, Ownership and control, Purpose. The primary purpose is to generate social and environmental benefits rather than focus on financial profits. Conversely, comparing the community energy practices in Turkey with examples around the world, it has been determined that there are problems in key issues such as access to debt capital, identification of roof areas and obtaining permits, availability of space for other RE facilities, stringent legal requirements, lengthy approval procedures, political resistance.

As a result of the literature reviews related to the thesis, local administration practices and interviews with sector experts, the following determinations have been made especially for solar energy applications. The part of the energy offered as a private sector service for electricity generation can provide economic and environmental support to local governments, especially with the development of solar energy technologies; its ease of application for household use and its cheaper costs. By creating the local solar energy strategies in the action plans of the municipalities, it can be ensured that the solar energy potentials of their regions are determined and the energy policies are rearranged. By establishing an Advisory Board / Council for solar energy within the local governments, solar energy installation targets can be determined.

As a result of the literature reviews, local administration practices and interviews with sector experts, there are concluding remarks for policy makers and local governments:

Concluding Remarks for Policy Makers

- *Clarifing the responsibilities assigned to different government levels*
- *Preparing legal regulations for community energy*
- *Ensuring that all responsibilities are sufficiently funded*
- *Supporting framework and sharing of power generation over existing network*
- *Encouraging citizen participation with an innovative management approach.*

Concluding Remarks for Local Governments

- *Enabling local solar energy strategies in the action plans of the municipalities*
- *Establishing Advisory Board or Council by members from relevant civil society, private sector and academician*
- *Developing different resources to have a balanced income*
- *Requiring the provision of renewable energy technologies and storage infrastructure in new buildings*
- *Ensuring public participation for affordable and accessible models with renewable energy cooperatives*

5.2. Recommendations for Further Research

The research that has been undertaken for this thesis highlighted several areas for further development and application for which further research would be beneficial.

One of the topics that can be addressed in further research may be other renewable energy projects implemented by local governments. In addition, the topics such as renewable energy supply agreements, hybrid plant applications, energy storage, green hydrogen, and energy efficiency in buildings can be included in further research. According to the reviews, by pioneering the establishment of financing models such as the introduction of renewable portfolio standards for local people and businesses, feed-in tariffs, low-interest credit models, tax incentives, it can be pioneered in the establishment of more fair, affordable and accessible models with renewable energy cooperatives.

In addition, Turkey ratified the Paris Agreement on 22 September 2021 and local energy applications are presented as driving and essential for success in the global energy transition. Within the scope of investments in low carbon technologies in energy production, demand-oriented renewable energy applications with high environmental and economic benefits can be the subject of further research in Turkey's urban policy planning and clean energy development.

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APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSI

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79 59
ueam@metu.edu.tr
www.ueam.metu.edu.tr

Sayı: 28620816 /

27 EKİM 2021

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç. Dr. Meltem Şenol Balaban

Danışmanlığını yürüttüğünüz Esengül ERKAN'ın "Yenilenebilir Enerjinin Topluluk Enerji Planlamasi Olarak Türkiye Yerel Yönetimlerindeki Rolü" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **420-ODTU-2021** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof. Dr. Mine MISIRLISOY
İAEK Başkanı

B. SOME OF THE MUNICIPALITIES THAT WANT TO DEVELOP SOLAR ENERGY PROJECTS WITH ILBANK SUPPORT

MUNICIPALITY	PROVINCE-DISTRICT	CAPACITY	LAND/ ROOFTOP	INVITATION LETTER (for grid connection)	IS THERE A TENDER?
T.C. Antalya Büyükşehir Belediyesi	ANTALYA - DÖŞEMEALTI	3 MW	LAND	YES	YES
T.C. Kepez Belediyesi	ANTALYA-KORKUTELİ	3 MW	LAND	NO	NO
T.C. Erzincan Havalimanı DHMİ	ERZİNCAN-MERKEZ	1 MW	LAND	YES	YES
T.C. Kuyucak Belediyesi	AYDIN-KUYUCAK	1,2 MW	LAND	YES	NO
T.C. Sarayönü Belediyesi	KONYA-SARAYÖNÜ	1 MW	LAND	YES	NO
T.C. Afşin Belediyesi	KAHRAMANMARAŞ-AFŞİN	1 MW	LAND	YES	YES
T.C. Akhisar Belediyesi	MANİSA-AKHİSAR	1 MW	LAND	YES	NO
T.C. Karpuzlu Belediyesi	AYDIN- KARPUZLU	0,6 MW	LAND	YES	NO
T.C. Küçükçekmece Belediyesi	İSTANBUL-KÜÇÜKÇEKMECE	0,20 MW	ROOFTOP	YES	NO
T.C. Küçükçekmece Belediyesi	İSTANBUL-KÜÇÜKÇEKMECE	0,08 MW	ROOFTOP	YES	NO
T.C. İETT İşletmeleri Genel Müdürlüğü	İSTANBUL-KURTKÖY	0,09 MW	ROOFTOP	YES	YES
T.C. Sandıklı Belediyesi	AFYONKARAHİSAR-SANDIKLI	0,6 MW	ROOFTOP	YES	NO
T.C. Bozkurt Belediyesi	KASTAMONU-BOZKURT	0,3 MW	LAND	YES	NO
T.C. Kütahya İl Özel İdaresi	KÜTAHYA - MERKEZ	0,4 MW	LAND	YES	YES
T.C. Burdur İl Özel İdaresi	BURDUR- MERKEZ	0,3 MW	ROOFTOP	YES	NO
T.C. Çağlayan Belediyesi	ERZİNCAN-MERKEZ	0,12 MW	LAND	YES	NO
T.C. Şarkikaraağaç Belediyesi	ISPARTA-ŞARKİKARAAĞAÇ	1 MW	LAND	YES	YES
T.C. Yalvaç Belediyesi	ISPARTA-YALVAÇ	1 MW	LAND	YES	NO
T.C. Uluborlu Belediyesi	ISPARTA-ULUBORLU	0,87 MW	LAND	YES	NO
T.C. Sarıidris Belediyesi	ISPARTA- EĞİRDİR	0,46 MW	LAND	YES	NO

T.C. Keçiborlu Belediyesi	ISPARTA-KEÇİBORLU	0,26 MW	LAND	YES	NO
T.C. Çiçekpınar Belediyesi	ISPARTA-ŞARKİKARAAĞAÇ	0,23 MW	LAND	YES	NO
T.C. Burdur Belediyesi	BURDUR- MERKEZ	1 MW	LAND	NO	NO
T.C. Karamanlı Belediyesi	BURDUR-KARAMANLI	1 MW	LAND	YES	NO
T.C. Burdur Belediyesi	BURDUR- MERKEZ	0,6 MW	ROOFTOP	YES	NO
T.C. Altınyayla Belediyesi	BURDUR-ALTINYAYLA	0,6 MW	LAND	YES	NO
T.C. Söğüt Belediyesi	BURDUR- ÇAVDIR	0,45 MW	LAND	YES	NO
T.C. Tefenni Belediyesi	BURDUR-TEFENNİ	0,3 MW	ROOFTOP	YES	YES
T.C. Çeltikçi Belediyesi	BURDUR-ÇELTİKÇİ	0,27 MW	LAND	YES	NO
T.C. Ağlasun Belediyesi	BURDUR-AĞLASUN	0,20 MW	LAND	YES	NO
T.C. Kocaaliler Belediyesi	BURDUR-KOCAELİLER	0,18 MW	ROOFTOP	YES	NO
T.C. Kemer Belediyesi	BURDUR-KEMER	0,12 MW	ROOFTOP	YES	NO
T.C. Ilgın Belediyesi	KONYA- ILGIN	0,15 MW	ROOFTOP	YES	NO
T.C. Felahiye Belediyesi	KAYSERİ- FELAHİYE	0,15 MW	ROOFTOP	YES	NO
T.C. Döşemealtı Belediyesi Ekolojik Kreş	ANTALYA-DÖŞEMEALTI	0,02 MW	ROOFTOP	YES	NO
T.C Taşköprü Belediyesi	KASTAMONU-TAŞKÖPRÜ	0,79 MW	LAND	YES	NO
T.C. Isparta İl Özel İdaresi	ISPARTA- KULEÖNÜ	0,775 MW	LAND	YES	NO
Bucak Organize Sanayi Bölgesi	BURDUR- BUCAK	0,38 MW	LAND	YES	YES
T.C. Gerede Belediyesi	BOLU - GEREDE			YES	YES
T.C. Kale Belediyesi	DENİZLİ - KALE	0,840 MW	LAND	YES	YES
T.C. Bodrum Belediyesi	MUĞLA - BODRUM	0,150 MW	ROOFTOP	YES	YES
T.C. Mamuca Belediyesi	ESKİŞEHİR - ODUNPAZARI	1 MW		YES	YES
T.C. Akçadağ Belediyesi	MALATYA - AKÇADAĞ	1 MW		YES	YES
T.C. Edremit Belediyesi	BALIKESİR - EDREMİT	0,180 MW		YES	YES
T.C. Derebucak Belediyesi	KONYA - DEREBUCAK	0,414 MW	LAND	YES	NO
T.C. Kazancı Belediyesi	KARAMAN - KAZANCI	0,195 MW	ROOFTOP	YES	NO
T.C. Çukurkuyu Belediyesi	ERZİNCAN-ÇUKURKUYU	0,250 MW	LAND	YES	NO
T.C. Kale Belediyesi	MALATYA -KALE	0,400 MW	LAND	YES	NO

T.C. Karşıyaka Belediyesi	İZMİR- KARŞIYAKA	0,990 MW	LAND	YES	NO
T.C. Bornova Belediyesi	İZMİR - BORNOVA	1 MW + 0,300 MW	ROOFTOP	YES	NO
T.C. Alpu Belediyesi	ESKİŞEHİR - ALPU	0,295 MW	LAND	YES	NO
T.C. Uşak Belediyesi	UŞAK - MERKEZ	0,510 MW	LAND	YES	NO
T.C. Şarkışla Belediyesi	SİVAS - ŞARKIŞLA	0,500 MW	LAND	NO	NO
T.C. Demirci Belediyesi	AKSARAY - DEMİRCİ	0,250 MW	LAND	YES	NO
T.C. Avanos Belediyesi	NEVŞEHİR - AVANOS	0,998 MW	LAND	YES	NO
T.C. Konaklı Belediyesi	NİĞDE - KONAKLI	0,100 MW	LAND	YES	NO
T.C. Ermenek Belediyesi	KARAMAN - ERMENEK	0,530 MW	LAND	YES	NO
T.C. Osmangazi Belediyesi	BURSA- OSMANGAZİ	1 MW	LAND	YES	NO
T.C.Çandır Belediyesi	YOZGAT - ÇANDIR	0,500 MW	LAND	YES	NO
Aski Genel Müdürlüğü	ANKARA	0,240 MW	ROOFTOP	YES	NO
T.C. Demirci Belediyesi	MANİSA - DEMİRCİ	0,500 MW	LAND	NO	NO
T.C. Sincan Belediyesi	ANKARA - SİNCAN	0,400 MW	ROOFTOP	YES	NO
T.C. Kahramanmaraş Büyükşehir Belediyesi	KAHRAMANMARAŞ-MERKEZ	0,420 MW	ROOFTOP	YES	NO
T.C. Karesi Belediyesi	BALIKESİR-KARESİ	1 MW	LAND	YES	NO
T.C. Fethiye Belediyesi	MUĞLA-FETHİYE	0,350 MW +0,350 MW	ROOFTOP	YES	NO
T.C. Reşadiye Belediyesi	TOKAT-REŞADİYE	0,600 MW		YES	NO
T.C. Niğde İl Özel İdaresi	NİĞDE-MERKEZ	0,600 MW	LAND	YES	NO
T.C. Konya Büyükşehir Belediyesi	KONYA- MERKEZ				NO
T.C. Seydikemer Belediyesi	MUĞLA-SEYDİKEMER	1 MW	LAND	YES	NO
T.C. Şırnak İl Özel İdaresi	ŞIRNAK- MERKEZ	0,960 MW	LAND	YES	NO
T.C. Beylikova Belediyesi	ESKİŞEHİR-BEYLİKOVA	0,100 MW	LAND	YES	NO
T.C. Kapaklı Belediyesi	TEKİRDAĞ-KAPAKLI	1 MW	LAND	YES	NO
T.C. Tunçbilek Belediyesi	KÜTAHYA - TUNÇBİLEK	0,500 MW	LAND	YES	NO
Sütcü İmam Üniversitesi	KAHRAMANMARAŞ	1 MW	LAND	YES	NO
T.C. Gaziantep Belediyesi	GAZİANTEP-MERKEZ	1 MW	LAND	YES	NO

T.C. Karaisalı Belediyesi	ADANA - KARAİSALI	1 MW	LAND	YES	NO
T.C. Eflani Belediyesi	KARABÜK - EFLANİ	1 MW	LAND	NO	NO
T.C. Kaymaklı Belediyesi	NEVŞEHİR - KAYMAKLI	0,300 MW	LAND	YES	NO
T.C. Afyonkarahisar Kırka Belediyesi	AFYONKARAHİSAR-KIRKA	0,300 MW	LAND	NO	NO
T.C. Dörtyol Belediyesi	HATAY - DÖRTYOL	0,806 MW	ROOFTOP	NO	NO
Adana Aski	ADANA -MERKEZ	0,600 MW	LAND	YES	NO
Denizli PTT Baş Müdürlüğü	DENİZLİ- MERKEZ	0,454 MW	LAND	NO	NO
T.C. Hacıbektaş Belediyesi	NEVŞEHİR-HACIBEKTAŞ	0,500 MW	LAND	YES	NO
Mehmet Akif Ersoy Üniversitesi	BURDUR - MERKEZ	1 MW	LAND	NO	NO
Asat Antalya Su ve Kanalizasyon Müdürlüğü	ANTALYA - MERKEZ	1 MW	LAND	YES	NO
Eğirdir Köylere Hizmet Götürme Birliği	ISPARTA - EĞİRDİR	0,200 MW	LAND	NO	NO
T.C. Ayvacık Belediyesi	ÇANAKKALE - AYVACIK	0,200 MW	LAND	YES	NO
S.S. Yesevi Yenilenebilir Enerji Üretim Kooperatifi	UŞAK	0,463 MW		IN THE EVALUATION PHASE	NO
S.S Ottoman Yenilenebilir Enerji Üretim Kooperatifi	AFYONKARAHİSAR	0,641 MW		IN THE EVALUATION PHASE	NO
S.S Cerit Köyü Sulama Kooperatifi	KARAMAN	0,96 MW	LAND	IN THE EVALUATION PHASE	NO
S.S Anka Yenilenebilir Enerji Üretim Kooperatifi	NEVŞEHİR	0,786 MW	LAND	IN THE EVALUATION PHASE	NO
S.S Salur Tarımsal Kalkınma Koop.	ISPARTA	0,18 MW	ROOFTOP	NO	NO
S.S Yassıbel Sulama Kooperatifi	ISPARTA	0,300 MW	LAND	NO	NO
T.C. Nilüfer Belediyesi	BURSA - NİLÜFER	0,96 MW	ROOFTOP	YES	NO
T.C. Ayaş Belediyesi	ANKARA -AYAŞ	0,120 MW	LAND	NO	NO
T.C. KazımKarabekir Belediyesi	KARAMAN - KARABEKİR	0,452 MW	LAND	IN THE EVALUATION PHASE	NO
T.C. Hacıabdullah Belediyesi	NİĞDE - HACIABDULLAH	0,150 MW	LAND	IN THE EVALUATION PHASE	NO
T.C. Süleymanpaşa Belediyesi	TEKİRDAĞ - SÜLEYMANPAŞA	0,300 MW	ROOFTOP	NO	NO
TOTAL		**59 MW**			

C. INSTALLED POWER GENERATION, YEKDEM SUPPORTS AND INCOME ITEMS FOR 3 DIFFERENT TYPES OF RENEWABLE ENERGY CURRENTLY IN PRODUCTION

Biomass Power Plant

PROJECT LOCATION	FACILITY COST	AMOUNT OF WASTE	MWm	MWe	MWh	YEKDEM	Unit Production	Energy Income (USD/MWm)	Energy Income (USD)
KONYA/AFYON/KAYSERİ	85.000.000,00	850 tons/day	9,64	9,36	70.200	13,3	7.285,18	96.892,90	933.660,00
MANİSA/İZMİR	67.290.000,00	591,5 tons/day	3,08	3,00	20.250	13,3	6.574,68	87.443,18	269.325,00
SİVAS/ERZİNCAN	15.710.000,00	39 tons/day	2,10	2,00	14.000	13,3	6.666,67	88.666,67	186.200,00
KONYA/AFYON/KAYSERİ	164.820.960,00	330 tons/day	12,75	12,00	90.000	13,3	7.057,16	93.860,27	1.197.000,00

Hydroelectric Power Plant

PROJECT LOCATION	FACILITY COST	FACILITY TYPE	MWm	MWe	MWh	YEKDEM	Unit Production	Energy Income (USD/MWm)	Energy Income (USD)
ANTALYA/BURDUR/ISPARTA	33.500.000,00	Channel Type	4,45	4,31	10.220	7,3	2.296,63	16.765,39	74.606,00
KASTAMONU/ÇORUM	51.660.000,00	Dam Type	5,32	5,00	13.000	7,3	2.443,61	17.838,35	94.900,00

Solar Power Plant

PROJECT LOCATION	FACILITY COST	FACILITY TYPE	RADIATION AMOUNT (kWh/m2)	MWm	MWe	MWh	YEKDEM	Unit Production	Energy Income (USD/MWm)	Energy Income (USD)
AFYONKARAHİSAR	1.428.000,00	Fixed Slope	1820	2,380	1,990	4.201	13,3	1.765,13	23.476,18	55.873,30
ANKARA	1.291.800,00	Fixed Slope	1650	2,153	2,100	3.141	13,3	1.458,89	19.403,30	41.775,30
HATAY	673.960,00	Fixed Slope	1880	1,162	0,990	1.899	13,3	1.634,25	21.735,54	25.256,70
NEVŞEHİR	7.620.480,00	Tracker+Bifacial	1710	12,096	10,000	22.573	13,3	1.866,15	24.819,85	300.220,90
ANTALYA	7.499.520,00	Tracker+Bifacial	1870	12,096	10,000	24.940	13,3	2.061,84	27.422,45	331.702,00
ANKARA	14.647.930,00	Fixed Slope	1650	24,013	20,000	36.121	13,3	1.504,23	20.006,22	480.409,30
ANTALYA	14.167.670,00	Fixed Slope	1870	24,013	20,000	40.633	13,3	1.692,13	22.505,26	540.418,90
NEVŞEHİR	7.257.600,00	Fixed Slope	1710	12,096	10,000	18.313	13,3	1.513,97	20.285,08	243.562,90

D. THESIS PERMISSION FORM

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☒

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : Erkan
Adı / Name : Esengül
Bölümü / Department : Kentsel Politika Planlaması ve Yerel Yönetimler

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